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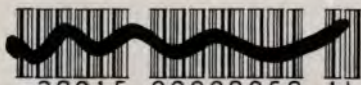
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U. S. DEPARTMENT OF AGRICULTURE.  
DIVISION OF MICROSCOPY.

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FOOD PRODUCTS.—I.

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TWELVE EDIBLE MUSHROOMS OF THE UNITED STATES,  
WITH  
DIRECTIONS FOR THEIR IDENTIFICATION AND  
THEIR PREPARATION AS FOOD.

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BY  
THOMAS TAYLOR, M. D.,  
CHIEF OF THE DIVISION OF MICROSCOPY.

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### INTRODUCTORY NOTE.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF MICROSCOPY,  
*Washington, D. C., March 6, 1894.*

SIR: I respectfully submit for republication a paper on Twelve Edible Mushrooms of the United States, first published as a part of my report for 1885, and reprinted in 1890 and 1893 in the series of bulletins prepared in this division on the subject of Food Products. The appendix included in the edition of 1893 is retained, and an additional article inserted on the Mushroom Industry.

Very respectfully,

THOMAS TAYLOR,  
*Microscopist.*

Hon. J. STERLING MORTON,  
*Secretary of Agriculture.*

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## TWELVE EDIBLE MUSHROOMS OF THE UNITED STATES.

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For several years past the Division of Microscopy of the U. S. Department of Agriculture has been in receipt of numerous letters from regular correspondents and others to the effect that in various localities, representing almost every section and climate of the Union, there are found large quantities of edible mushrooms and other allied fungi, few of which are utilized because the great majority of the people do not know how to distinguish the edible from the poisonous species. To obtain some clear and trustworthy criteria by which to make this essential distinction has been the object of the various communications received, and, in view of the highly nutritious properties of this class of esculents and of the great possible value of their aggregate product, as indicated by the vast quantities produced in countries where attention is given to their cultivation, the importance of a satisfactory answer to these inquiries will be readily appreciated.

### FOOD VALUE OF MUSHROOMS.

Rollrausch and Siegel, who claim to have made exhaustive investigations into the food values of mushrooms, state that "many species deserve to be placed beside meat as sources of nitrogenous nutriment," and their analysis, if correct, fully bears out the statement. They find in 100 parts of dried *Morchella esculenta* 35.18 per cent of protein; in *Helvella esculenta*, 26.31 per cent of protein, from 46 to 49 per cent of potassium salts and phosphoric acid, 2.3 per cent of fatty matter, and a considerable quantity of sugar. The *Boletus edulis* they represent as containing in 100 parts of the dried substance 22.82 per cent of protein. The nitrogenous values of different foods as compared with the mushroom are stated as follows: "Protein substances calculated for 100 parts of bread, 8.03; of oatmeal, 9.74; of barley bread, 6.39; of leguminous fruits, 27.05; of potatoes, 4.85; of mushrooms, 33.0." A much larger proportion of the various kinds of mushrooms are edible than is generally supposed, but a prejudice has grown up concerning them in this country which it will take some time to eradicate. Notwithstanding the occurrence of occasional fatal accidents through the inadvertent eating of poisonous species, fungi are largely consumed both by savage and civilized man in all parts of the world, and while they contribute so considerable a portion of the food product of the world we

may be sure their value will not be permanently overlooked in the United States, especially when we consider our large accessions of population from countries in which the mushroom is a familiar and much prized edible.

In France mushrooms form a very large article of consumption and are widely cultivated. Mushroom beds are cultivated in caves, frequently miles in extent. A cave at Mery is mentioned as containing, in 1867, 21 miles of beds, and producing not less than 3,000 pounds daily. Another at Frepillon contains 16 miles of beds. The catacombs and quarries of Paris and vicinity, and the caves of Moulin de la Roche, Sous Bicetre, and Bagneux produce immense quantities of mushrooms. They are all under Government supervision, and are regularly inspected like the mines.

The mushroom which is cultivated in these quarries and caves almost to the exclusion of all others is the "Snow Ball" (*Agaricus arvensis*). The truffle is held in high esteem and is largely exported. In 1872 the quantity of truffles exported from France was valued at over 3,000,000 francs. In 1879 at nearly 10,000,000 francs. Immense quantities of the *Agaricus deliciosus* are sold in the Marseilles markets. The *Fistulina hepatica* is also in great demand, and many other varieties appear from time to time in the markets throughout France. The natives of Australia use largely a truffle which attains a weight of more than 2 pounds, and is known under the name of "native bread." The Chinese, who are noted for the care bestowed on their esculent vegetation, consume large quantities of edible fungi, importing largely from Japan and Tahiti. The trade in edible fungi from Tahiti to China commenced about the year 1866; in 1868 only 70 tons were shipped; in 1873 135 tons were exported to China, and in 1874 152 tons were exported.

The value of mushrooms imported by Shanghai from Tahiti in 1872 was 107,000 taels, and in 1873 138,800 taels—the tael is worth about 6 shillings sterling, or about \$1.50 in United States currency. The fungus shipped (*Hirneola auricula-Judæ* B.) is said to be very rich in fungine and nitrogen. It is a very bulky freight; 10 tons will occupy the room of 30 tons ordinary freight.

A very laudable practice of the Chinese Government alluded to in an English journal, and which might perhaps be advantageously adopted in this country, is the publishing for annual gratuitous distribution of numerous treatises, describing the different herbs which can be utilized in whole or in part for food purposes. One of these treatises is called the "Anti-Famine Herbal," and consists of six volumes, containing descriptions, with illustrations, of over four hundred plants which can be used as food. These volumes are of inestimable value in districts where the ravages of insects, drought, etc., have destroyed the grain and rice crops, and famine is imminent. For some years past New Zealand has exported large quantities of an edible fungus to San Francisco and Hongkong for use of the Celestials. A full account of this

Industry may be obtained from the United States consular reports. The gathering and drying of the fungus give profitable employment to large numbers of colonial children, as well as to the Maoris. The species grows abundantly in the wooded regions of New Zealand, and when dry is worth from 4 to 5 pence a pound. The Chinese, who are singularly free from prejudice in the matter of food, use it, as they do the edible nest of their swallow, as a chief ingredient in their favorite soup. They also employ it as a medicine, and, stranger still, for making a valuable dye for silk. Another remarkable edible fungus of New Zealand is the *Sphæria Robertsii*, which grows out of the body of a large caterpillar, practically converting the latter into vegetable substance. The caterpillar lives under ground, and the fungus springs upward through the soil till it reaches a height of 8 or 10 inches. It is eaten by the Maoris, who use it also, when burned, as a coloring matter.

The Japanese grow several species of edible fungi in logs of decaying wood in a manner peculiar to themselves, and, aside from the home consumption, they in one year exported to China mushrooms to the value of \$60,000. In 1879 mushrooms were exported from Japan to the value of 243,440 yens. The yen is equal to 99.7 cents. Among the northeastern tribes of Asia fungi are largely used as food. One species, when pounded, forms their snuff, while another, the *Fly Agaric*, which is utilized in Europe as a fly killer, and is regarded as one of the most poisonous forms, is used by them as a substitute for ardent spirits. One large specimen is sufficient "to produce a pleasant intoxication for a whole day," the alcohol being obtained by the usual method of fermentation. In many parts of Europe fungi are a favorite food, being eaten fresh, and also preserved in vinegar for winter use. For pickling purposes, all kinds, it is said, are gathered, the vinegar being supposed to neutralize the alkaline poison of the noxious species. The common mushroom, the morel, and the truffle are, however, the favorite edible fungi. In Italy the value of the mushroom as an article of diet has long been understood and appreciated. Pliny, Galen, and Dioscorides mention various esculent species, notably varieties of the truffle, the boletus and the puffball. At Rome it has been the custom of the Government to appoint inspectors to examine all the mushrooms brought into market and to reject such as are poisonous or worthless, which are thrown into the Tiber. It was forbidden also to hawk mushrooms about the streets, and all were required to be sent to the central depot for inspection.

The yearly average of the taxed mushrooms sold (all over 10 pounds being taxed) in the city of Rome alone, for the past decade, has been estimated at between 60,000 and 80,000 pounds weight. Large quantities of mushrooms are consumed in Germany, Hungary, Russia, and Austria, and in the latter country a list is published, by authority, of those mushrooms which upon official examination may be sold. Darwin speaks of Terra del Fuego as the only country where cryptogamic

plants form a staple article of food. A bright yellow fungus allied to *Bulgarin* forms, with shellfish, the staple food of the Fuegians. In England the common meadow mushroom *Agaricus campestris* is quite well known and used to a considerable extent among the people, but there is not that general knowledge of and use of other species which obtains on the continent. Much has been done of late years by the Rev. M. J. Berkeley, Dr. Curtis, Dr. C. D. Badham, Dr. M. C. Cooke, Worthington G. Smith, Prof. Charles Peck, and others to disseminate general knowledge on this subject. That America is rich in the quantity and variety of her esculent fungi is readily seen by the fact that one hundred and eleven species of edible fungi have been described by the Rev. Dr. Curtis, State botanist of North Carolina, as indigenous to that State alone. Late investigations show that nearly all the species common to the countries of Continental Europe are found in different localities in the United States. Dr. J. J. Brown, of Sheboygan, Wis., writes that edible mushrooms are found in his neighborhood in great abundance.

In preparing this paper for publication I have made selections from such of the species of edible mushrooms as have marked peculiarities of structure, habits, taste, odor, color, juice, and change of color of juice on exposure to the atmosphere.

#### TWELVE EDIBLE SPECIES.

##### *Lactarius deliciosus* Fr. *Orange Milk Mushroom.*

Fig. 1.

This mushroom (*Lactarius deliciosus*) is highly recommended by different authors. It belongs to the Lactars or milk-bearing group. As a group the milk-bearing mushrooms are generally viewed with suspicion, but the species "deliciosus" receives general commendation as an esculent. It is easily distinguished from any other of the group by the orange or red color of the milk which exudes from it when cut or broken. The flesh changes on exposure to the atmosphere, as does the milk also, and becomes a dull green color. This mushroom has a firm, juicy flesh; its richly colored orange top is commonly, but not invariably, marked with zones of a deeper color. The stem is often spotted red; the gills or lamellæ are the same color as the cap or pileus. It is found in plantations of fir and pine and in swampy woods. A poisonous mushroom of this subgenus similar in shape and size can be readily distinguished from it by its white milk, which does not change. The flavor of *Lactarius deliciosus* when cooked is said to resemble that of "kidney stew."

*Method of cooking.*—The rich gravy it produces is its chief characteristic, hence it commends itself for sauces or as an ingredient in soups. It requires delicate cooking, as it becomes tough if kept over the fire until its juice has evaporated. Baking is perhaps the best method of preparing this mushroom for the table.

**Cantharellus cibarius Fr. Chanterelle.**

Fig. 2.

Wherever found, this species (*Cantharellus cibarius*) grows in great abundance. It is very popular in Europe, where in some localities the inhabitants make it their principal food. It is easily recognized by its rich color and the peculiar form of its gills. It is generally found in light woods and high situations. The pileus is lobed and irregular in shape. When young it is dome-like, the margin rolled in; as it approaches maturity the margin expands, forming an irregular wavy line, and the center of the pileus becomes depressed. The color is orange or deep yellow, somewhat resembling that of the yolk of an egg. The stem is tough, yellow, and solid, becoming hollow in maturity. The gills, which appear like short branching veins, are thick and wide apart, and are of the same color as the pileus. The texture is smooth, the flesh yellow and dense, and has a pleasant odor. Vittadini compares it to that of plums. It is somewhat dry and tough in character, and therefore requires slow and protracted stewing, with plenty of liquid. In selecting for culinary purposes, crisp and heavy ones should be chosen in preference to light and soft ones, as being less likely to become leathery in cooking. Some recommend soaking them in milk over night to render them tender.

Mrs. Hussey gives the following receipt:

Cut the mushrooms across and remove the stems; put them into a closely covered saucepan, with a little fresh butter, and sweat them until tender at the lowest possible temperature. A great heat always destroys the flavor.

A deleterious species (*Cantharellus aurantiacus*), often found in rank grass or decaying herbage, is of the same color, and by a careless observer might be taken for the wholesome species. A little care and attention to detail, however, will enable one to distinguish one from the other. In the *Cantharellus aurantiacus* the pileus is covered with down and the veins or gills are crowded, thin, and of a much deeper color than the pileus.

**Marasmius oreades Bolt. Fairy Ring Champignon.**

Fig. 3.

This mushroom (*Marasmius oreades*) is represented by all mycologists as one of the most highly flavored. It grows in rings in short pastures, on downs, and by road sides, but never in woods. It is very well marked, somewhat tough, the solid stem particularly so. In color it is a bright buff. The gills are wide apart and are of a cream color. When dried it can be kept for years without losing its flavor. "It is much used in the French *à la mode* beef shops in London, with the view of flavoring that dish." Dr. Badham, Rev. M. J. Berkeley, and Mr. Worthington G. Smith, of England, highly recommend the *Fairy Ring Champignon*, and it is said by experts in the culinary art that, when

boiled with butter, it has an exquisitely rich and delicious flavor. Mr. Berkeley says it is so common in some districts in England that bushels may be gathered in a day.

Another species of this genus (*M. peronatus*, or Hairy Foot), found growing in woods, on dead leaves, is to be avoided. The gills of this species are darker in color and narrower. It has a hairy down at the base of the stem by which it may also be distinguished.

***Hydnum repandum* L. Hedgehog or Spine Mushroom.**

Fig. 4.

The genus *Hydnum* being so well defined, having spines instead of gills or pores, is easily distinguished from all others.

The pileus of the species *repandum* is irregular in shape, depressed in the center, fleshy, and of a pale cinnamon or yellowish color.

Flesh firm and white, turning slightly brown when bruised. The spines are awl-shaped, of various sizes, crowded and running down; paler in color than the pileus. Stem solid, at first white, and then tawny cream color; spores round and white. There are no poisonous species in this genus, although some are too tough to be considered edible.

The species *repandum* is the most desirable of the genus *Hydnum*. M. Roques, an eminent French mycologist, says:

The general use of this fungus throughout France, Italy, and Germany leaves no room for doubt as to its good qualities.

It is common in oak and pine woods in England. Mrs. Hussey recommends stewing this mushroom in brown or white sauce.

Cook slowly and for a long time and keep well supplied with liquid, it being naturally deficient in moisture.

Its dry nature makes it easy to preserve, and it may be kept for a great length of time.

***Agaricus campestris* L. Meadow Mushroom.**

Fig. 5.

To distinguish this species (*campestris*, or meadow mushroom) requires very little discrimination. The cap or pileus is fleshy, white, or tawny, sometimes brownish. When it is in its best condition for use the gills are a beautiful pink in color, ultimately becoming a deep brown, which reaches nearly to the stem, which carries a well-marked white woolly ring or volva. The cap is usually more or less adorned with minute silky fibrils. The margin generally extends a little beyond the outer extremity of the gills. It has an enticing fragrance, and the white flesh is sometimes inclined to change to pink when broken. It grows in open grassy places in fields and rich pastures, but never in thick woods.

It may be prepared for the table by stewing with butter, spice, parsley, sweet herbs, salt and pepper, and a little pure lemon juice. It makes a fine catsup, and cut up in small pieces and stewed with butter makes an agreeable adjunct to a steak or mutton chop. The catsup may be used to give flavor to soup or beef tea.

This mushroom should be eaten fresh and served hot.

Dr. Badham says:

The mushroom having the same proximate principles as meat, requires, like meat, to be cooked.

Mr. Worthington G. Smith says:

The *Agaricus arvensis* (horse mushroom) is a species very nearly allied to the meadow mushroom and frequently grows with it, but it is coarser and has not the same delicious flavor. It is usually much larger, often attaining enormous dimensions; it turns a brownish yellow as soon as broken or bruised. The top in good specimens is smooth and snowy white; the gills are not the pure pink of the meadow mushroom, but a dirty brownish white, ultimately turning brown. It has a big, ragged, floccose ring, and the pithy stem is inclined to be hollow.

*Coprinus comatus* Fr. *Maned Agaric*.

Fig. 6.

The maned agaric (*Coprinus comatus*) is considered one of the most delicious of all the mushroom tribe when young. The cap is first cylindrical, then bell-shaped, then expanded, more or less scaly, and split longitudinally. The flesh is thick in the center and very thin at the margin. The gills are free, and at first white or pinkish, then black, soon melting into an inky fluid, the color of which is due to the presence of black spores. The ring on the stem is moveable, then disappears. The stem is white and hollow. This mushroom grows in waste and grassy places, lawns, and meadows. Only young specimens are desirable for esculent purposes. Mr. Worthington G. Smith, as the result of considerable experience, observes:

It must be noted, however, that when too young this agaric is rather deficient in flavor and its fibers tenacious. Its flavor is most rich and its texture most delicate when the gills show the pink color with sepia margins.

It decays rapidly and should be cooked immediately after gathering. A very simple method is to broil and serve on toast.

*Morchella esculenta* P.

Fig. 7.

This mushroom is known under a variety of names—*Phallus esculentus*, *Helvella esculenta*, etc. The genus *Morchella* has but few species, and most authors agree that all are edible. Berkeley considers the *Morchella semilibera* as doubtful. The head of the morel is deeply pitted, hollow, thin, and firm, and when fully grown is several inches in diameter. The morel is found in April and May, in grassy places, on the

border of fields and the raised banks of streams, sometimes in fir or chestnut forests and in hilly countries. It prefers a calcareous ground and flourishes on wood ashes.

In Germany, France, and England it is well known and highly esteemed. In the United States it is little known, although it grows in several of the States in great abundance. I have had specimens of it from Missouri, Wisconsin, and Maryland. Curtis speaks of finding it in North Carolina, but not in quantity. It is identical with the European morel. In Yorkshire, England, the women who gather cowslips for wine-brewing bring to market a few morels in the corners of their baskets and ask an extra shilling for them. The dried morel is used in parts of England to give a flavor to certain kinds of sauce. Large quantities of this fungus, in a prepared condition, are imported into England from the continent.

The following receipt will illustrate one of the methods of cooking this excellent mushroom:

Having washed and cleaned from them the earth which is apt to collect in the hollows of the plants, dry them thoroughly in a napkin, and put in a saucepan with pepper and salt and parsley, adding, or not, a piece of ham; stew for an hour, pouring in occasionally a little broth to prevent burning. When sufficiently done, bind with the yolks of two or three eggs and serve on buttered toast.

#### *Clavaria cinerea* Bull.

Fig. 8.

Of this species (*Cinerea*) M. C. Cooke observes:

It has a short, thick stem, is very much branched and irregular, and becomes ultimately of a cinereous hue. The substance is brittle, and not tough as in some species. In France it is known under various names, as *Piéd de coq*, *Gallinole*, etc., and in Italy as *Ditolarossa*; in both of those countries it is eaten.

It is quite plentiful in this country. I have had some fine specimens from the White Mountains. All the white spored *Clavarias* are wholesome.

#### *Clavaria rugosa* Bull.

Fig. 9.

This species (*Clavaria rugosa*) is not generally found in sufficient quantities to make it of much value as an esculent, but it is wholesome, and can be cooked with other varieties of the genus. It is irregular in shape, white, and sometimes the tips are delicately tinted with a greenish gray. Before cooking, the plants should be sweated with butter over a slow fire and the liquor thrown away. They may then be wrapped in slices of bacon and stewed for an hour in a little sauce or gravy, seasoned with salt, pepper, and parsley, then served with white sauce.

**Boletus edulis Bull. Edible Pore Mushroom.**

Fig. 10.

Dr. Badham says:

The word *Boletus*, which has at different times and under different mycologists been made to represent in turn many different funguses, is now restricted to such as have a soft flesh, vertical tubes underneath, round or angular, slightly connected together and with the substance of the cap, open below and lined by the sporiferous membrane; the cap horizontal, very fleshy; the stalk generally reticulated.

In this group it has been said that there are but few edible species and some that are very deleterious. The flesh of the poisonous species, it has been said, also invariably turns blue when bruised or broken, but this test, I think, can not be relied upon. "The *Boletus edulis*," says Badham, "can not be mistaken for any other *Boletus*, because it alone presents the following characters united, viz: A cap, the surface of which is smooth; tubes, the color of which varies with each period of its growth; beautiful and singular reticulation of the stalk, especially towards the upper portion, and a *flesh which is white and unchanging*."

The cap is brown. At first the tubes are white, then pale yellow, and when mature, a dull greenish yellow. For table use the specimens should be gathered when the tubes are pale yellow; it is then most tender. The stem is solid and quite thick, at first white, but turning to a light brown in maturity, displaying near the top a network of pinkish veins. It is sold in quantities in Italy. It is also quite popular in Hungary, Germany, and Russia, and other European countries. It grows most abundantly in the autumn, although often found in spring and summer. It is found chiefly in the woods, more especially of pine, oak, and chestnut. The following receipt for cooking the *Boletus* is given by Persoon:

It may be cooked in white sauce with or without chicken in fricassee, broiled or baked with butter, salad oil, pepper, salt, chopped herbs, and bread crumbs, to which add some ham or a mince of anchovy.

Its flesh is tender and juicy and it requires less cooking than some of the tougher mushrooms.

**Lycoperdon giganteum Batsch. Puffball.**

Fig. 11.

The giant puffball (*Lycoperdon giganteum*), so generally neglected, is one of the most valuable of the edible mushrooms. It is readily distinguished from other puffballs and allied fungi by its large size, it being from 10 to 20 inches in diameter, and by its form is easily separated from all other mushrooms. It is somewhat globose in form, whitish, or pale yellowish brown in color, filled with a soft white flesh when immature, which changes to an elastic, yellowish brown, cottony, but dusty mass of filaments and spores when mature.

In this state the peel or rind breaks up and gradually falls away in fragments. I have made full inquiry regarding it among mycologists and have not found a dissenting voice as to its value as an esculent. They all agree as to its edibility and tender character. All the species are edible, but the smooth-skinned varieties are more palatable than the rough-skinned.

Vittadini, an Italian mycologist, says:

When the giant puffball is conveniently situated you should only take one slice at a time, cutting it horizontally, and using great care not to disturb its growth, to prevent decay, and thus one may have a fritter every day for a week.

Dr. M. C. Cooke, the eminent London mycologist, writes with enthusiasm of the merits of the giant puffball as an esculent, deeming it a delightful breakfast relish.

Mrs. Hussey, of England, gives the following receipt for "puff-ball" omelet:

First remove the outer skin; cut in slices half an inch thick; have ready some chopped herbs, peppers, and salt; dip the slices in the yolk of an egg and sprinkle the herbs upon them; fry in fresh butter and eat immediately.

The puff-balls must be gathered young. If the substance within is white and pulpy it is in good condition for dressing, but if marked with yellow stains it should be rejected.

The puff-ball is found growing in many parts of the United States and a few fine specimens have been forwarded to this Department for inspection. I have myself tested a fine specimen of the giant puff-ball found in the Department Grounds, finding it delicious eating when fried in egg batter.

I am informed that the giant puffball (*Tycoperdon giganteum*) is found in great abundance growing on the Genesee Flats, Livingstone County, N. Y.

J. M. Dodge, Glencoe, Nebr., writes to the U. S. Department of Agriculture, April 9, 1878:

I am much interested in the article "Edible Fungi," published in the Department Report for 1876. We have here a species of puffball which when young has firm, white flesh, and I think would be good to eat. It sometimes grows to a large size. It is quite abundant on the prairie in summer, and if edible would offer a large amount of food.

A correspondent of the Argus, Clayton, Mo., October 14, 1887, writes:

The United States Agricultural Report of 1885 gives clear descriptions and beautiful drawings of twelve typical edible fungi. Of these, No. 7, *the morel*, page 105, in the spring, we use large quantities. Since the late rains we have had twice a day a full supply of No. 6, *Maned agaric*, as a stew, and No. 11, "puffball," fried as a fritter. It is a misfortune that so little is known of this valuable class of products that are given by bountiful nature by the ton without any labor whatever. The nation is deeply indebted to Dr. Taylor, Microscopist, U. S. Department of Agriculture, for these clear details and most reliable, lifelike drawings, and we hope they will be issued as a separate bulletin and sent out among the people by the million. Give us more light on those subjects.

**Fistulina hepatica Fr. Liver Fungus.**

Fig. 12.

This fungus (*Fistulina hepatica*) is frequently found on old oaks, chestnuts, and ash. It develops from the rotten bark. It appears first as a rosy pimple at any time during the summer season. In a very short time it becomes tongue-shaped and assumes the color of a beet-root. In a few days it changes form again, becoming broad in comparison to its length and changing color to a deep blood-red. Its lower surface is often paler than its upper, it being tinged with yellow and pink hues. It requires about two weeks to attain its highest development, after which it gradually decays.

It varies in size from a few inches to several feet in circumference. Rev. M. J. Berkeley mentions one which weighed 30 pounds. It has been styled, the "*poor man's fungus*," and in flavor resembles meat more than any other.

When young and tender it can be sliced and broiled or minced and stewed, making a delicious dish. When old, the stock is rather tough for good eating, but the gravy taken from it is equal to that of the best beefsteak. The following receipt for cooking this fungus is recommended:

Slice and macerate it, add pepper and salt, a little lemon, and minced eschalots, onions, or garlic; then strain and boil the liquid, which makes most excellent beef gravy.

This fungus is esteemed in Europe, where it is eaten prepared in a variety of ways. Where it grows at all, it grows abundantly. I have found some fine specimens in the District of Columbia.

**METHODS OF CULTIVATION.**

Many methods of cultivating the common meadow mushroom have been presented by different growers, but all agree as to the value of the general methods in practice. Nearly every farm and nursery affords the conditions necessary to cultivate the ordinary field mushrooms, such as sheltered sheds, stables, and small hot-beds for winter cultivation, and melon patches, cucumber pits, etc., for summer culture.

Mushroom spawn in "bricks" can be easily obtained from the seedmen. Natural or virgin spawn, which is considered by many experienced growers as preferable to the artificial, can be obtained in most places where horses are kept. It is found in half-decomposed manure heaps, generally where horse droppings have accumulated under cover. It is readily distinguished by its white filamentous character, and by its mushroom odor. When dried it can be kept for years.

Mushroom beds are easily formed on the floor of sheds, by carrying in the fresh stable dung, adding to it about one-fourth of good loam, mixing both together, pressing firmly down, and letting the mass remain about two weeks untouched. By this time the temperature will

be on the decline, and when it falls to 90° F., break the bricks of spawn into pieces 2 inches square, and plant 12 inches apart, 3 inches below the surface, holes having been made for the purpose by means of a rounded stick. Fill up the opening made, level with the surface. Under favorable conditions the spawn will appear on the surface, spreading its white filaments through the mass within ten or twelve days. On the appearance of the spawn on the surface, cover over to the depth of 3 inches with good garden soil, and press down firmly. Should the conditions prove unfavorable, spawn failing to appear, it is better to insert fresh spawn, or to remake the bed, adding fresh materials, if it is found that the materials have spent their heat-producing powers.

By some it is deemed advisable not to put the spawn at any uniform depth, but so that while one piece of it may be at a depth of 6 inches, or nearly so, others may touch the surface, which allows the spawn to vegetate at a depth and temperature most congenial to it. Mushrooms may also be cultivated for family use in warm cellars, in boxes about 4 feet square and 18 inches deep.

## APPENDIX.

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### DIRECTIONS FOR THE PREPARATION AND SPAWNING OF MUSHROOM BEDS.

The following practical directions for the preparation and spawning of mushroom beds have been transcribed from Mr. William Falconer's valuable treatise, "Mushrooms, and How to Grow Them," and are appended in the belief that they will form a valuable supplement to the preceding pages:

#### PREPARING THE BEDS.

When enough manure has accumulated for a bed, prepare it in the following way: Turn it over, shaking it up loosely and mixing it all well together. Throw aside the dry strawy part, also any white "burnt" manure that may be in it, and all extraneous matter, as sticks, stones, old tins, bones, leather straps, rags, scraps of iron, or such other trash as we usually find in manure heaps, but do not throw out any of the wet straw; indeed we should aim to retain all the straw that has been well wetted in the stable. If the manure is too dry, do not hesitate to sprinkle it freely with water, and it will take a good deal of water to well moisten a heap of dry manure. Then throw it into a compact oblong pile about 3 or 4 feet high and tread it down a little. This is to prevent hasty and violent heating and "burning," for firmly packed manure does not heat up so readily or whiten so quickly as does a pile loosely thrown together. Leave it undisturbed until fermentation has started briskly, which, in early fall, may be in two or three days, or in winter, in six to ten days; then turn it over again, shaking it up thoroughly and loosely and keeping what was outside before inside now, and what was inside before toward the outside now; and if there are any unduly dry parts moisten them as you go along. Trim up the heap into the same shape as before and again tread it down firmly.

This compacting of the pile at every turning reduces the number of required turnings. When hot manure is turned and thrown loosely into a pile it regains its great heat so rapidly that it will need turning again within twenty-four hours in order to save it from burning, and all practical men know that at every turning ammonia is wasted, the most potent food of the mushroom. We should therefore endeavor to

get along with as few turnings as possible; at the same time never allow any part of the manure to burn, even if we have to turn the heap every day. These turnings should be continued until the manure has lost its tendency to heat violently, and its hot rank smell is gone—usually in about three weeks' time. If the manure, or any part of it, is too dry at the turning, the dry part should be sprinkled with water and kept in the middle of the heap. Plain water is generally used for moistening the manure, but I sometimes use liquid from the stable tanks, which not only answers the purpose of wetting the dry materials, but it is also a powerful stimulant and welcome addition to the manure. But the greatest vigilance should be observed to guard against overmoistening the manure; far better fail on the side of dryness than on that of wetness.

If the manure is too wet to begin with it should be spread out thinly and loosely and exposed to sun and wind, if practicable, to dry. Drying by exposure in this way is not as enervating as "burning" in a hot pile; and better have recourse to any method of drying the manure than use it wet. If, on account of the weather or lack of convenience for drying, the manure can not be dried enough, add dry loam, dry sand, dry half-rotted leaves, dry peat moss, dry chaff, or dry finely-cut hay or straw, and mix together.

The proper condition of the manure as regards dryness or moistness can be readily known by handling it. Take a handful of the manure and squeeze it tight; it should be unctuous enough to hold together in a lump and so dry that you can not squeeze a drop of water out of it.

Some private gardeners in England lay particular stress upon collecting the fresh droppings at the stable every day and spreading them out upon a shed or barn floor to dry, and in this way keeping them dry and from heating until enough has accumulated for a bed, when the bed is made up entirely of this material or of part of this and part of loam. But market gardeners, the ones whose bread and butter depend upon the crops they raise, never practice this method, and that patriarch in the business, Richard Gilbert, denounces the practice unstintedly. Different growers have different ideas of preparing manure for mushroom beds, but the aim of all is to get it into the best possible condition with the least labor and expense, and to guard against depriving it of any more ammonia than can be helped.

#### SPAWNING THE BEDS.

After the mushroom bed is made up it should, within a few days, warm to a temperature of 110° to 120° F. Carefully observe this, and never spawn a bed when the heat is rising or when it is warmer than 100°, but always when it is on the decline and under 90°. In this there is perfect safety. Have a ground thermometer and keep it plunged into the bed; by pulling it out and looking at it one can easily know exactly

the temperature of the bed. Have a few straight smooth stakes, like short walking canes, and stick the end of these into the bed, 12 to 20 feet apart; by pulling them out and feeling them with the hand one can tell pretty closely the temperature of the bed.

All practical mushroom-growers know that if the temperature of a 12-inch thick bed at 7 inches from the surface is  $100^{\circ}$  that within an inch of the surface of the bed will only be about  $95^{\circ}$  indoors and  $85^{\circ}$  to  $90^{\circ}$  out of doors. Also, that when the heat of the manure is on the decline it falls rapidly 5, often 10, degrees a day till it reaches about  $75^{\circ}$ , and between that and  $65^{\circ}$  it may rest for weeks.

Some years ago I gave considerable attention to this matter of spawning beds at different temperatures. Spawn planted as soon as the bed was made (five days after spawning, the heat in interior of bed ran up to  $123^{\circ}$ ) yielded no mushrooms, the mycelium being killed. The same was the case in all beds where the spawn had been planted before the heat in the beds had attained its maximum ( $120^{\circ}$  or over). Where the heat in the middle of the bed never reached  $115^{\circ}$ , the spawn put in when the bed was made and molded over the same day yielded a small crop of mushrooms. A bed in which the heat was declining was spawned at  $110^{\circ}$ ; this bore a very good crop, and at  $100^{\circ}$  and under to  $65^{\circ}$ , good crops in every case were secured with several days' delay in bearing in the case of the lowest temperatures. But, notwithstanding these facts, my advice to all beginners in mushroom-growing is, wait until the heat of the bed is on the decline and has fallen to at least  $90^{\circ}$  before inserting the spawn.

Writing to me about spawning his bed, Mr. Withington, of New Jersey, says: "I believe a bed spawned at  $60^{\circ}$  to  $70^{\circ}$  and kept at  $55^{\circ}$  after the mushrooms appear will give better results than one spawned at a higher temperature, say  $90^{\circ}$ ."

Here is the oddest thing about Mr. J. G. Gardner's method of mushroom-growing. He does not give the manure any preparatory treatment for the beds. He hauls it from the cars to the cellar, at once spreads it upon the floor, and packs it solid into a bed. For example, on one occasion the manure arrived at Jobstown, July 8. It was hauled home and the bed made up the same day, and the first mushrooms were gathered from this bed the second week in September, just two months from the time the manure left the New York or Jersey City stables. The bed was 15 inches thick. In making it the manure was first shaken up loosely to admit of its being more evenly spread than if pitched out in heavy forkfuls, and it was then tramped down firmly with the feet. The bed was then marked off into halves. On one-half (No. 1) a layer of a little over 3 inches of loam was at once placed over the manure. On the other half (No. 2) no loam was used at this time, but the manure on the surface of the bed—about 3 inches deep—was forked over loosely. Twelve days after having been put in the temperature of the bed No.

2 (3 inches deep) was 90° and then it was spawned. On the next day the soil from bed No. 1, spawned four days earlier, was thrown upon bed No. 2, and then part of the soil that was thrown on No. 1 was thrown back again on No. 2, so that now a coating of loam an inch and a half deep covered the whole surface of the bed. When finished the surface was tamped gently with a tamper with a face of pine plank 16 inches long by 12 inches wide. Mr. Gardner does not believe in the alleged advantages of a hard-packed surface on the mushroom bed, but is inclined to favor a moderately firm one.

### THE MUSHROOM INDUSTRY.

The following review of the mushroom industry of the United States is condensed from a paper read by Mr. William Falconer, of Glen Cove, N. Y., at a meeting of the Massachusetts Horticultural Society held in Boston, Mass., in February, 1894:

Mushroom-growing is becoming quite an important industry in this country, and is attracting great attention. Until a few years ago a veil of mystery hung over this branch of horticulture, and gardeners alone indulged in it. Mushrooms were cultivated in the dark in caves and cellars; the seed was not sown, plants were not set out, spawn was indefinable. Successful cultivators were silent, and the general public were kept in darkness. Within the last four years mushroom-growing in this country has quadrupled. The production has not, however, kept pace with cultivation, for there have been failures. But the industry has become firmly planted, not only among professional horticulturists, but among amateurs; indeed, some of the largest growers are manufacturers and others who, having unoccupied caves or cellars, have gone into the business with the view of utilizing room that would otherwise be idle and unproductive. Florists have planted thousands of square yards under their greenhouse benches that otherwise would be worthless to them. In their case mushrooms are a comparatively inexpensive auxiliary to their business, and nearly all they make above the expense of labor and spawn is net profit, for they need the loam and rotted manure in their florist work. Chicken-raisers have also taken to the mushroom business for profit; they want to grow something that will bring them in money in the winter time. This increased production will reduce the price from a fictitious to a popular basis and place on the table of the middle classes a wholesome delicacy which before had been restricted to the wealthy; and many persons who now use the tasteless indigestible putty balls from imported cans will repudiate the foreign article and accept no other than the wholesome, toothsome, juicy domestic product.

But we should see to it that the price of mushrooms does not fall so low as to render their cultivation unprofitable. This may be done by proclaiming their virtues and making them popular with the multitude.

To make them generally popular three things are necessary, namely, to increase the supply, moderate the price, and bring them before the notice of the people. If mushrooms could be obtained at moderate prices, the demand would increase tenfold at once. A Philadelphia gentleman writes that one thing we have pressing need for is a good distributing agency in every good city. If Philadelphia were properly canvassed by a well-equipped company for distributing the product of the growers direct to the consumers, it would use twenty times as many mushrooms as it now does. There are a few commission fruit men there who have most of the business and cater to some of the hotels, but the enormous host of well-to-do people are not approached at all. These well-to-do people are lamentably ignorant of the delicious morsel and need educating to the gastronomic delights they are missing by not having fresh mushrooms frequently on their tables. The cooks also need educating, for few of them can cook mushrooms. When improperly cooked they are tough, leathery, dry, and tasteless; when properly cooked they are the most delicious morsels in the vegetable kingdom, with an aroma to tempt the gods.

As now grown mushrooms are a somewhat uncertain crop. We may have the most extravagant success one year and only partial success the next, and yet, so far as we know, the materials, preparation, and care were the same in both cases. Now we must discover, first, what caused the success, that we may stick to it; and, secondly, what caused the failure, that we may avoid it. No one should attempt to grow mushrooms who has not a good place—shed, cellar, greenhouse, stable, or the like—and only the best materials should be used, that is, good fresh horse manure, clean, sweet loam, and a superior spawn. The most vital point is the preparation of the manure, which should be moist but never wet, and above all should not burn or “fire-fang.”

It is just as easy to grow mushrooms on a small scale for home use as it is to grow flowers or strawberries and comparatively with no more expense. In fact, when we do the work ourselves we do not reckon any expense, and we reap a delicious luxury for our pains. Charles L. Hill, of San Francisco, who has a large canning factory, has in connection with it what he calls a “mushroom factory,” which consists of ranges of sheds filled with beds. His object in starting it was to have something to can in winter. His houses are so arranged that he does the work of loading and unloading the manure by machinery, and runs it in and out of the houses on little railroad cars. The only drawback to raising mushrooms in summer is that they are then attacked by flies which produce maggots. The bowels of the earth, as in caves and abandoned quarries, are inhospitable places to this pest, and mushrooms can as well be grown in them in summer as in winter. In the village of Akron, about 30 miles from Buffalo, N. Y., are tunnels from which stone has been taken to make hydraulic cement and which have been utilized for growing mushrooms. The largest and most successful

grower has nearly 3 acres in beds. The temperature of these caves varies only from 56° in winter to 65° in summer. American growers have not hitherto generally succeeded in making as good spawn for propagating mushrooms as is imported from France and England, and consequently the importations from these countries have greatly increased during the last three years. When the American spawn is equally potent, it is not offered in as attractive form as the European, and the tendency of home growers has been to charge a higher rate for what they manufacture.

#### A NEW SPECIES.

Mr. Falconer described a new species of mushroom, *Agaricus subrufescens* Peck. In the summer of 1892 he observed quantities of a rather uncouth looking mushroom, which was new to him, growing wild on and about piles of leaf mold. They are not scattered about as mushrooms which are found in the field, but grew in bunches of two, three, or more—a dozen or two frequently growing together. But the crop was not steady. There might be a great quantity one week, hardly any the next, lots the following week, and so on. After a rain they would spring up like magic. There were about forty loads of rotting leaves in the pile, and in forking into it a gentle heat was found all summer. The spawn of the mushroom had run through the whole mass over 2 feet deep. The best ones grew in the two or three year old mold. His attention was called to the fact that a neighboring florist was picking a large quantity of mushrooms from his greenhouses and selling them at high prices in New York. Mr. Falconer went and saw them and found the statements true, but instead of the common mushroom (*Agaricus campestris*) it proved to be the same stranger he was studying at home. It appeared with the florist there the year before. Old violet beds in his grape and tomato house were full of mushrooms; old hotbeds in the nursery were run over with them, and they were growing in the open ground among his asparagus between rows of pear trees. Wherever planted they were coming up like a crop of weeds, and in sunshine and shade with apparent indifference. He had a bonanza and was increasing his mushroom-growing facilities; but while the mushroom has behaved with varying grace to him since then, it has not been so productive as it was the first year. It was pronounced a new species by Prof. C. H. Peck, State botanist of New York, and was named by him *Agaricus subrufescens*.

There is no doubt that this species has come to stay, especially as a summer crop. Before now the price of spawn—\$5 for a 5-pound package—was prohibitory; but the spawn of the new species will be offered this spring cheap enough for every person to try it. It will be sold as flake spawn—that is, not in bricks, but in the condition in which we get the French spawn—and probably at \$1.50 a bushel or \$5 a barrel. It is not only extraordinarily productive, but, unlike the ordinary mush-

room, it can be grown in summer; for it springs up so fast that the larvæ of the little flies have hardly time to develop before the mushrooms are ready for use. It is, however, no more maggot-proof than the old one. Its disadvantages are its toadstool appearance, its uncertain behavior, and the fact that the crop comes in spurts, lots to-day and none to-morrow. But further acquaintance may overcome the dislike to its looks and practical experience control its behavior. Bulk for bulk it is not as heavy as the common mushroom. Though its cap is deeper and broader, it is thinner and therefore lighter. It does not burst its veil as soon as the old kind, but after it does it gets old very quickly. It is very good to eat, having a pronounced mushroom flavor and exuding a fair quantity of juice. The flesh is also tender. Several persons whom Mr. Falconer knows prefer it to the common mushroom, though he was still inclined to favor his old and toothsome friend *A. campestris*.

This new mushroom requires more heat and more water than the old. In one case, where a bed of mushrooms about one-fourth grown stood still for three or four days, after a good soaking they swelled up finely and gave an immense crop. Watering is generally injurious to young mushrooms of the old species. The new species grows as well in winter as in summer, provided the cultural conditions are as favorable. It will grow in a cellar of Egyptian darkness as well as in the daylight; in fact, darkness whitens it and robs it of much of its outdoor coarseness. One cultivator thought it not quite as good for shipping as *A. campestris*, but for home trade and gathered when fresh his customers pronounced it superior to that species. Mr. Falconer said that, notwithstanding the uncertainty of mushroom-growing, one man on Long Island had been at it uninterruptedly for thirty years, and had made more money in it than any other man in the same trade in America.









U. S. DEPARTMENT OF AGRICULTURE.  
DIVISION OF MICROSCOPY.

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FOOD PRODUCTS.—II.

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EIGHT EDIBLE AND TWELVE POISONOUS MUSHROOMS  
OF THE UNITED STATES,

WITH

DIRECTIONS FOR THE CULTURE AND CULINARY PREPARATION  
OF THE EDIBLE SPECIES.

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BY

THOMAS TAYLOR, M. D.,  
CHIEF OF THE DIVISION OF MICROSCOPY.

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## INTRODUCTORY NOTE.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF MICROSCOPY,  
*Washington, D. C., September 22, 1893.*

SIR: The paper presented herewith, which formed part of my report for the year 1890, was reprinted in 1891, becoming No. 2 in the series of reports issued from this division under the general title of Food Products. As the first edition of this report is now exhausted and the popular demand for information relative to the culture and use of mushrooms still continues, the printing of a second edition is respectfully requested.

Very respectfully,

THOMAS TAYLOR,  
*Microscopist.*

HON. J. STERLING MORTON,  
*Secretary of Agriculture.*

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## EIGHT EDIBLE AND TWELVE POISONOUS MUSHROOMS OF THE UNITED STATES.

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The following paper was prepared with a view to supplement my first report on edible mushrooms of the United States, which appeared originally in the annual report of this Department for the year 1885, and has since been reprinted as the first number in the series of bulletins on food products. The present report contains descriptions and illustrations of eight additional species of edible mushrooms common in the United States, together with an account of simple and improved methods of mushroom culture, and certain recipes for preparing mushrooms for the table which may be found useful in localities where as yet this savory, nutritious, and abundant article of food has not been utilized. Twelve of the poisonous varieties are also illustrated and their distinguishing characteristics described.

### CAUTIONARY SUGGESTIONS.

Before collecting for the table mushrooms found growing in the woods or fields, it will be well for inexperienced persons to consult carefully some work on the subject in which the characteristics of edible and poisonous varieties are described and illustrated. The taste and odor of a mushroom are quite significant, and colors also should be carefully observed. All mushrooms found growing in filthy places should be rejected, and those which yield a white milk when the gills are bruised should also be avoided, as they are generally poisonous.

The common puff-ball, for table use, should have a white flesh, a firm texture, and should be free from insects. The small warty puff-ball has a bad odor and is not used.

There is a yellow mushroom known to botanists as *Lactarius deliciosus* which is edible and yields an orange milk when bruised. It is a bright golden yellow, having an odor that has been compared to that of apricots, and is found plentifully in some of the States, though practically unknown to the public. For a further description of it, see Plate 1, Fig 1, in my first paper on this subject, "Food Products—I: Twelve Edible Mushrooms of the United States."

A class of mushrooms known as *Boleti* supplies many edible species. Select none for table use but such as are found growing or in a fresh

condition. In the edible varieties the flesh remains white when broken, but of those which turn quickly a deep blue some are poisonous. According to some writers, several of the species which turn blue are edible. My advice is, discard all Boleti, the flesh of which turns blue on exposure to the air, until we have more reliable data upon this subject. The Boleti have pores instead of gills. Edible Boleti have generally a shaded brown top; the pores underneath may be first whitish, then green or yellow. For culinary purposes remove the spore tubes and stalks. The outer skin of the top is peeled off, when they may be dried on strings, like cut apples, and kept for use. Although this class is not generally regarded as edible in the United States, "it is sold commonly in all stores where beans, barley, and such food substances are kept on sale in Germany." (Cooke.)

#### EIGHT EDIBLE MUSHROOMS OF THE UNITED STATES.

[Description of Plate 1.]

FIG. 1. The "Plum" mushroom (*Agaricus prunulus*).—Of this species Worthington G. Smith gives the following description: "The pure pink gills running considerably down the ringless stem, and the fresh, fragrant smell of meal, at once distinguish this species from all others. The solid stem and very fleshy top are white or some shade of very pale gray. The flesh is firm, juicy, and full of flavor, and broiled or stewed it is a most delicious morsel." It grows in and near damp woods. Its top will measure from 1½ to 6 inches across.

FIG. 2. The "Variable" mushroom (*Russula heterophylla*).—This species is known by its sweet, nutty taste, and is very common in the woods. Its gills are white and sometimes branched; flesh, white; stem, solid, white, and ringless; top, firm, variable in color, as its name indicates; the thin, viscid covering of the pileus is commonly subdued green, but at one time approaches greenish yellow or lilac, and at another, gray or obscure purple. The top is at first convex, becoming concave; it is excellent baked with salt, pepper, and butter, between two dishes.

FIG. 3. The "Scaly" mushroom or Parasol agaric (*Agaricus procerus*).—This is by some thought superior to the "Common" or "Meadow" mushroom. Robinson says: "Whenever an agaric on a long stalk enlarged at the base presents a dry cuticle more or less scaly, a darker colored umbonated top, movable ring, and white gills, it must be *Agaricus procerus*, the Parasol agaric, and it may be gathered and eaten without fear. When the whitish flesh is bruised it shows a light reddish color." It grows in pastures and woods and is known by its long, bulbous, spotted stem, by the ring that will slip up and down, by the very scaly top, and the gills far removed from the stalk at its insertion. Diameter of top 5 to 8 inches.

FIG. 4. The "Honey-colored" mushroom (*Armillaria mellea*).—This very common species is not highly esteemed in some countries where other and better sorts can be had. Pileus, fleshy; color, pale rufus, more or less shaded with yellow. It grows in tufts on old stumps. Stem, elastic; gills, pallid, and running down the stem. This is a most desirable mushroom, when young, cap about an inch and a half in diameter.

FIG. 5. *Lepiota cepæstipes*, var. *cretaceus*.—This very delicate and beautiful agaric is found on tan and leaves in hothouses. The specimens here delineated I found in one of the hothouses of the Department gardens. Its color is very pure white throughout. Both stem and pileus are covered, as seen in the drawing, with small chalky tufts. "This species," says Berkeley, "is probably of exotic origin, as it never grows in the open air." It is met with in the hothouses of Europe. (Peck.)



EIGHT EDIBLE MUSHROOMS COMMON TO THE UNITED STATES.







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TWELVE POISONOUS MUSHROOMS.

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FIG. 6. The "Horse" mushroom (*Agaricus arvensis*).—This species, found in fields and pastures in the autumn, is, when young and fresh, most desirable eating. The top in good specimens is snowy white; gills, pinkish, turning to brown, ultimately becoming brownish black. It has a big ragged, floccose ring and pithy stem inclined to be hollow. As soon as broken or bruised this mushroom turns a brownish yellow. Its flesh is firm and delicious, and yields an abundant gravy.

FIG. 7. *Cortinarius cornuolens*.—Pileus, fleshy, a very beautiful blue color; gills a pure blue; stem, also blue with margined bulb. A cobweb-like filament frequently extends from the base of the stem to the margin of the pileus. Skin is viscid when moist. Grows on stumps.

FIG. 8. The "Oyster" mushroom (*Agaricus ostreatus*).—Found on dead tree trunks, in the autumn. Top, cinereous in color; gills, white; stem, eccentric or altogether wanting. It usually grows in masses one above another. Worthington G. Smith says of this species: "A dish of them stewed before a very hot fire has proved as enjoyable and nourishing as half a pound of fresh meat." *A. ostreatus* may be dressed in any of the usual ways, but is better cooked over a slow fire.

## TWELVE POISONOUS MUSHROOMS.

### [Description of Plate 2.]

FIG. 1. The "Red Juice" mushroom (*Hygrophorus conicus*).—This species is common in pastures and roadsides. It has a strong and unpleasant odor; flesh, juicy; color of the top, crimson or a deep orange; taste, bitter; stem, hollow. It is found in groups on old tree stumps.

FIG. 2. The "Emetic" mushroom (*Russula emetica*).—This dangerous species has a bright scarlet or rose-colored top, sometimes shaded with purple. The skin is readily peeled off, exposing the flesh, which is white. It is very acrid to the taste. Gills, white; stem, white, sometimes pinkish; length about 2½ inches.

FIG. 3. The "Verdigris" mushroom (*Agaricus aeruginosus*).—Pileus, fleshy; convexo-plane, covered with green mucus; stem, long, hollow, and scaly, tinged with blue; gills, brown, tinged with purple. This mushroom quickly decays. Top is about 3 inches across.

FIG. 4. The "Satanical" tube mushroom (*Boletus satanas*).—By far the most splendid of all the Boleti. Top, nearly white, very fleshy, and a little viscid. Stem, firm, exquisitely reticulated. The under surface of the pileus is bright crimson. When bruised or broken the inner fleshy substance becomes a deep blue. As its name indicates, this belongs to the class of tube or pore-bearing fungi. The pores are upon the under surface of the pileus and take the place of the gills or lamellæ of the *Agaricini* group.

FIG. 5. The "Trellised" clathrus (*Clathrus cancellatus*).—This is a poisonous mushroom of great beauty and variety. The fætor exhaled from it is most repulsive. In the young plant, however, the bad odor is not so strong, or may be altogether wanting.

FIG. 6. The "Spring" mushroom (*Agaricus (Amanita) vernus*).—This agaric is found in the woods in the spring, and is white in all its parts. It is supposed to be very poisonous.

FIG. 7. The "Fiery" tube mushroom (*Boletus piperatus*).—One of the smaller Boleti. Taste, highly acrid; grows in woods; it is probably dangerous; never attains a large size.

FIG. 8. The "Fly" mushroom (*Agaricus (Amanita) muscarius*).—This species, allied to the perfectly wholesome red-fleshed mushroom, *Amanita rubescens*, is a bright yellow just beneath the skin; the rest is white. It is usually a bright scarlet on top, sometimes a deep yellow or orange. Few species can exceed it in beauty. It grows in some places in such profusion as to make the very ground scarlet. Found in birch and pine woods.

FIG. 9. The "Ruddy-milk" mushroom (*Lactarius rufus*).—Pileus fleshy, umbonate, at length funnel-shaped, dry, zoneless, dark rufous; stem stuffed, rufous; gills crowded, ocherous, and rufous. On bruising the gills a white milk exudes which is extremely acrid and corrosive, a distinguishing mark.

FIG. 10. The "Fiery milk" mushroom (*Lactarius piperatus*).—So called from the powerfully acrid milk which it contains, white and abundant. When the milk is placed on the lips or tongue it produces the sensation of scalding or searing with a hot iron. Color white, inclining to cream; flesh firm and solid. Found in dry wood. Recently considered by some authors harmless when properly cooked, it losing thus its acrid character.

FIG. 11. The "Bitter" tube mushroom (*Boletus felleus*).—This mushroom is rare. Pileus is soft, smooth, brown, inclining to reddish gray; stem solid above, attenuated, reticulated; tubes or pores angular, flesh color, as well as the fleshy substance of the pileus when broken. The flesh is very bitter.

FIG. 12. Fetid "Wood-Witch" (*Phallus impudicus*).—If this species had not been eaten, it would hardly be necessary to refer to it. It is offensive and dangerous.

#### MUSHROOM CULTURE.

In the first attempts to raise mushrooms artificially, young living mushrooms were transferred from pastures to gardens and manure heaps, and fullgrown mushrooms were broken up, the fragments steeped in water, and the infusion applied to a bed thought to be suitable.

Mushrooms were first grown from spawn in the seventeenth century. At that time gardeners and nurserymen sought in pastures for the supposed true spawn. The first successful attempts at mushroom-growing from such spawn were made by introducing it into melon and cucumber beds at the time the melon seeds were sown. At the present day "virgin spawn" is obtained from old rich pastures where horses and oxen have been feeding. This spawn is made up with partially dried cakes of compacted horse and cow dung and earth. If the cakes are too wet or too dry the spawn will not run; it runs best and with greatest vigor in a moist heat of from 70° to 75° F. Cocoa-fiber waste is a good ingredient in mushroom beds; the spawn freely runs in it. In the prepared cakes the spawn, if good, will generally live in a resting state for five years. It has been known to live for twenty years. In France it is usual to apply niter (saltpeter) in weak solutions to mushroom beds for the purpose of increasing the size of the mushroom. In 1879 M. Charollois exhibited at the Central Horticultural Society of Paris a basket of mushrooms produced from spawn by sowing the spores on a plate of glass kept constantly moist and sprinkled with dung; the spawn thus produced was transferred to a mushroom bed. (See "Sowerby's Models of British Fungi.")

Dr. Gautier relates that the late distinguished chemist, M. Chevreul, a member of the French Academy of Sciences, after he had attained the age of 90, exhibited at the Academy of Sciences a few magnificent looking mushrooms that he had produced by causing the spores to germinate on a pane of glass covered with damp sand; afterwards selecting the most vigorous plants and sowing or planting their myce-



FIG 1.



PYRAMIDAL MUSHROOM BED ON FLOOR OF CELLAR.

FIG 2.



MUSHROOMS GROWN IN BOTTOM OF OLD CASK.

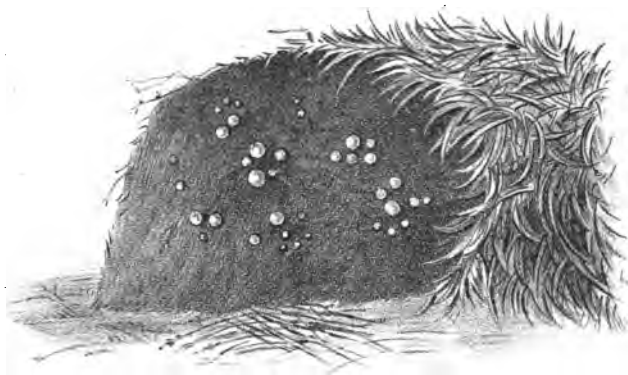
FIG 3.



MUSHROOM BED ON RUDE SHELF AGAINST WALL OF CELLAR.

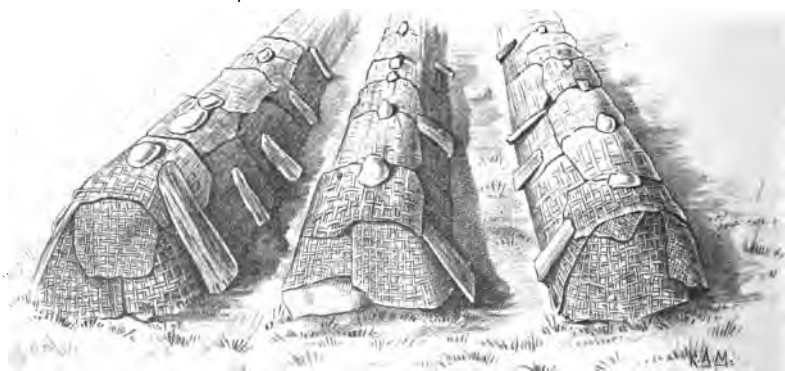


FIG. 4.



UNCOVERED END OF MUSHROOM-BED IN PARIS MARKET-GARDEN.

FIG. 5.



MUSHROOM-BEDS IN MARKET-GARDENS, KENSINGTON, ENGLAND.

lium in the damp soil of a cave, consisting of a richly manured mold covered with a layer of sand 2 inches deep, then with another layer of gravel, or the débris of a building, to the depth of about an inch. This bed was watered with a weak solution of nitrate of potash and at the end of a few days the mushrooms had attained an enormous size.

The French often cultivate mushrooms in cellars as well as in caves. The cellar should be warm and dry, as dark as possible, and free from drafts. Only two species thus far have been successfully cultivated, viz., *Agaricus campestris*, and an allied species, *A. arvensis*. Plates 3, 4, and 5 illustrate several modes of cultivation.

FIG. 1, PLATE 3, represents a pyramidal-shaped mushroom bed made on the floor of the cellar, which should be at least 2 feet 6 inches in diameter. They are built in the shape of an old-fashioned sugar-loaf, about 3 feet in height; the pieces of spawn placed 1½ inches deep and 16 inches apart.

FIG. 2, PLATE 3, represents mushroom culture in barrels sawed into two pieces crosswise, each forming a tub. Holes are made in the bottom of each tub and a thin layer of good soil is spread over them inside. They are then filled with good, well-prepared stable manure, as in the case of ordinary mushroom beds. When the tub is nearly full of material, well pressed down, six or seven good pieces of spawn are placed on the surface and the remainder of the tub is covered with two inches of garden mold and placed in a warm cellar.

FIG. 3, PLATE 3, shows a mushroom bed upon a shelf in a stable. Strong bars of iron are driven into the walls, upon which are placed shelves of the proper size covered with earth, upon which is formed a bed that is treated exactly as those made upon the ground. These beds are just as productive as any other kinds.

Mushrooms may be grown in all kinds of greenhouses, "stoves," pits, and frames. Some of the best crops, according to Robinson, have been raised in cold greenhouses, almost too ruinous to grow anything else. Mushrooms may be grown in the open air in gardens. The Paris growers never attempt their culture in summer, the summer insects being very destructive to mushrooms. The London gardeners very rarely do so. It is in winter that their cultivation is carried on in full vigor in the open air. Abundant crops are grown in the open air by the market gardeners of London and Paris. From their beds mushrooms are gathered in quantities in midwinter as well as in autumn.

FIG. 4, PLATE 4, represents the uncovered end of a mushroom bed in a Paris market garden. The horse manure is collected for a month or six weeks before the beds are made. All rubbish, chips, etc., are carefully taken out and the heaps are raised generally 2 feet thick and pressed down with the fork. When this is done the bed is well stamped and, if very dry, slightly watered with a rose. It is left in this state for eight or ten days, by which time it has begun to ferment, after which the bed should be well turned over and re-made on the same place, placing the manure that was at the sides in the center of the heap on turning and re-making. The mass is then left ten days more, at the end of which time the manure is about in proper condition for making the beds that are to bear the mushrooms. Little ridge-shaped beds about 26 inches wide and the same in height are then formed in parallel lines at a distance of 20 inches apart and of any desired length. (See Fig. 5, Pl. 4.) The beds once made of a firm close-fitting texture, the manure soon begins to warm again, but does not become unduly hot for the spread of the spawn. The spawn is inserted generally within a few inches of the base, about

13 inches apart, it having been ascertained beforehand that the heat is genial and suitable. The pieces of spawn used are about the size of three fingers and the manure is closed over and pressed firmly around them. This done, the beds are covered with about 2 inches of rich mold. If, after the lapse of ten or twelve days, the white filaments are seen spreading in the bed the cultivator knows that the spawn is good; if not, the spawn is rotting and must be removed and replaced with better. When the spawn is seen spreading well through the beds, the bed should be covered with fresh, sweet, rich soil of the garden and applied equally and firmly with a shovel to the depth of about an inch or so. A covering of abundance of litter or old mats is put on after the beds are earthed and kept in place by means of tiles, bricks, old boards, or any such materials for protection. The beds will soon be in full bearing, and it is thought better to examine and gather from them every second day or even every day if there are many beds. Occasional watering in a dry season is necessary. The beds are spawned at a temperature of about 80° F.

FIGS. 6 and 7, PLATE 5, represent a mushroom house and sections designed with a view to growing mushrooms during the greater part of the year without the aid of artificial heat. It is constructed, as will be seen, in such a way as not to be affected by changes of the external temperature. The walls are hollow and banked round with the soil excavated from the interior. The roof is thatched with reeds and the ends are of studwork, lined inside with boards and outside with split larch poles, the cavity to be filled with sawdust or cut straw; a small diamond-shaped ventilator, hung on pivots, should be fixed in each end. The floor may be of concrete or burnt clay, well rammed, and the beds are retained in their places by boards nailed to good oak posts. Care should be taken to provide efficient drains so that no stagnant damp may exist about the building.

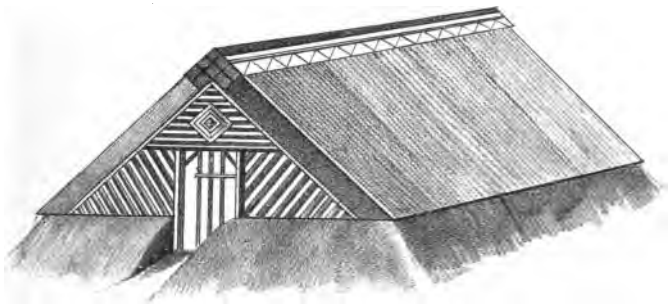
As the Department of Agriculture has had frequent inquiries as to mushroom spawn and how and where to obtain it, the following, taken from "Robinson on Mushroom Culture," is inserted for the benefit of those whom it may concern:

Generally the spawn is supposed to be analogous to *seed*. It is really what may be termed the vegetation of the plant, or something analogous to roots, stems, and leaves of ordinary plants, the stem, head, and gills of the mushroom being in fact the fructification. Spawn is found in a natural state in half decomposed manure heaps, in places where horse droppings have accumulated and been kept dry, and rarely or never in very moist or saturated materials. This natural spawn is the best, and should be used wherever it can be found. Divide the white spawn into pieces a few inches square, and an inch or more thick. They will, of course break up irregularly, but all should be used, whether of the size of a bean or nearly that of the open hand. In most places where horses are kept, opportunities occur of finding this spawn. Its white filamentous and downy threads have the odor of mushrooms and the spawn is therefore very easily recognized. It need not be used when found, but may be dried and kept in a dry place for years. It has been known to keep as long as fourteen years. To preserve spawn found in a natural state nothing more is required than to take up carefully the parts of the manure in which it is found, not breaking them up more than may be necessary, and placing the pieces of all sizes loosely in rough shallow hampers. Place these in some airy loft or shed till thoroughly dry, and afterwards pack in rough boxes till wanted for use.

#### ARTIFICIAL MUSHROOM SPAWN.

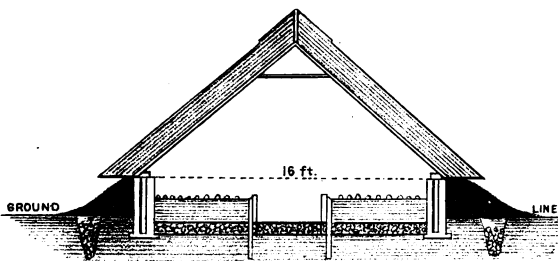
This spawn is made from horse droppings and some cow dung and road scrapings beaten up into a mortar-like consistency in a shed and then formed into bricks slightly differing in shape with different makers,

FIG. 6.



VIEW OF UNHEATED MUSHROOM-HOUSE.

FIG. 7.



SECTION OF PRECEDING FIGURE.



but usually thinner and wider than common building bricks. The following proportions are about the best: (1) Horse droppings the chief part; one-fourth cow dung; remainder loam. (2) Fresh horse droppings mixed with short litter for the greater part; cow dung one-third; and the rest mold or loam. (3) Horse dung, cow dung, and loam, in equal parts. These bricks are placed in some airy, dry place and when half dry a little bit of spawn about as big as a hazelnut is placed in the center of each, or sometimes when the bricks are as wide as long, a particle is put near each corner, inserted just below the surface and plastered over with the material of the brick. When nearly dry the bricks are placed in a hotbed about a foot thick in a shed or dry place. The bricks are piled openly and loosely and covered with litter so that the heat may circulate evenly among them, not above 60° F. If the temperature should exceed this it may be reduced by removing the covering of the litter. The bricks are frequently examined during the process, and when the spawn has spread throughout the brick like a fine white mold it is removed and allowed to dry for future use, in a dark place. If allowed to go further than the fine white-mold stage and to form threads and tubercles in the bricks it has attained a higher degree of development than is consistent with preserving its vegetative powers.

French mushroom spawn differs from our own in not being in the form of bricks or solid lumps but in rather light masses of scarcely half decomposed, comparatively loose, dry litter. This spawn is obtained by preparing a little bed as if for mushrooms in the ordinary way and spawning it with morsels of virgin spawn if obtainable. When the spawn has spread through it the bed is broken up and used for spawning beds in the caves or dried and preserved for sale. It is sold in small boxes, and is fit for insertion when pulled in rather thin pieces about half the size of the open hand. In separating it, it divides into many small pieces, every particle of which should be used. The small particles should be strewn broadcast over the bed after the larger pieces have been inserted. There is no necessity for purchasing artificial spawn at all where mushrooms are regularly grown; nor is there in any case, except at the commencement or to guard against one's own spawning proving bad. To secure good spawn we have only to do as the French growers do, take a portion of a bed where it is thoroughly permeated by the spawn, and before it begins to bear, and preserve it for future use.

What practical mushroom-growers call spawn, botanists term mycelium. Keeping the spawn dry merely suspends its growth; as soon as it is again submitted to favorable conditions of moisture and heat its pristine activity returns. The brick spawn is commonly known as English spawn, and what is imported into this country is made in England, mostly about London.

"Mill-track" spawn used to be considered the best in England, but it has been superseded, although European gardeners still call for the

English spawn under the name of "mill track." The real "mill track" is the natural spawn that has spread through the thoroughly amalgamated horse droppings in mill tracks or the cleanings from mill tracks. It is usually sold in large, irregular, somewhat soft lumps, and is much esteemed by spawn-makers for their "bricks." But nowadays, that horses have given place to steam as a motive power in mills, we have no further supply of "mill-track" spawn for use in spawning our mushroom beds. The "flake" spawn is what is generally known as the French spawn, and is imported into this country from France. It is put up in two ways, namely, nicely packed in wooden boxes, each containing 2 or 3 pounds of spawn; and also loose in bulk, when it is sold by weight or measure.

"Virgin" spawn is what we call natural spawn or wild spawn; that is, the spawn that occurs naturally in the fields, in manure piles or elsewhere and without any artificial aid. Virgin spawn is supposed to be produced directly from the mushroom spores and is not a new growth of surviving parts of old spawn that may have lived over in the ground. It is far more vigorous than "made" spawn, and spawn-makers always endeavor to get it to use in spawning the artificial spawn. It is not easy to obtain. Now and again we come upon a lot of it in a manure pile; it looks like a mass of netted white strings traversing the manure. As soon as discovered, secure all you can find, bring it indoors to a loft or shed or room and spread it out to dry; after drying thoroughly keep it dry and preserve and use it as you would French spawn, for it is the best kind of "flake" spawn. Spawn should be kept in a dry, airy place, somewhat dark if convenient, and in a temperature between 35° and 65° F. If the spawn is perfectly dry and kept in a dry, airy place, and not in large bulk and covered, it will bear a high temperature with apparent impunity, but whenever dampness, even of the atmosphere, is coupled with heat the mycelium begins to grow and this in the storeroom is ruinous to the spawn. My experience is, that frost destroys the vitality of both "brick" and "flake" spawn. How long spawn may be kept without impairing its vitality is an unsettled question, but there is no doubt that if properly kept it will remain good for several years. Do not use any old spawn. It is three months from the time the manure is gathered for the beds, until the mushrooms are harvested. Can any one afford to court failure in an enterprise which takes so much time and is attended with so much care and expense by using old spawn? If we could positively tell good from bad spawn we would never use bad spawn and therefore with ordinary care would have very few failures in mushroom growing, for good spawn is the root of success in this business. Spawn differs very much in its appearance; sometimes the "bricks" show very little evidence of the presence of spawn and still are perfectly good; again, we may get "bricks" that are pretty well interlaced and clouded with bluish white mold or fine threads, and this, too, is good; when the

"bricks" are freely pervaded with pronounced white threads this is no sign that the spawn is bad; "bricks" dried as hard as a board may be perfectly good; so, too, may be those that are comparatively soft. Mushroom spawn should have a decided smell of mushrooms and, whatever cobweb-like mold may be apparent, should be of a fresh bluish white and the fine threads a clear white. Prominent yellowish threads or veins are a sign that the mycelium started to grow and was killed. Distinct white mold patches on the surface of the "bricks" indicate the presence of some other fungus parasitic on the mushroom mycelium; the absence of any mushroom smell in the spawn indicates its worthlessness, and that the mycelium is dead. One familiar with mushroom spawn can tell with considerable certainty "very living" spawn from "very dead" spawn, but I am far from convinced that any one can decide unhesitatingly in the case of "middling" or "weak" spawn. M. Lachaune says that good spawn shows an abundance of bluish-white filaments well fitted together and giving off a strongly marked odor of mushrooms. All those portions which show traces of white or yellow mold or have a floury appearance should be rejected and destroyed. Mr. Wright says a brick may be a mass of moldiness and yet be quite worthless; and if the mold has a spotted appearance, as if fine white sand had been dredged on and through the mass, it is certain there is no mushroom-growing power there. If thick threads pass through the mass and there are signs of miniature tubercles on them, then the spawn may be regarded as too far gone. Clusters of white specks on the spawn denote sterility. As two lots hardly ever come exactly alike, it is hardly possible to give precise rules to follow excepting the never-failing requisite which the spawn must possess to be good, namely, the moldy appearance on the surface, the more the better, without showing threads. Too many of these to a given space are a sure indication of exhausted vitality arising generally from the bricks being heaped together when in process of manufacture before they are sufficiently dried. Healthy bricks are usually of a dusty brown color and light of weight. Black-colored spawn is to be avoided as a rule and when the black appearance is very prevalent in a cargo of "bricks" it is a strong indication that the spawn has not run its course, and as it is not expected to do so after it has reached the hands of the retailer, it is economy to cast it aside. It is not necessary to break a "brick" apart to see how it looks inside, nor even necessary to lay hands on it. The outward moldy appearance is the best of all evidence of its healthy vitality and this never exists in "bricks" that have lost their germinating power, excepting, of course, where they have been kept damp and the spawn has spent its power, which is detected by white threads appearing in great quantity. (Letter of A. D. Cowan, of New York, in Mr. Falconer's book, page 85.)

For further excellent advice as to making "brick" spawn, "flake" spawn, and the French "virgin" spawn, see the excellent treatise on

the subject of mushroom cultivation published by Mr. Falconer in 1891 and for sale by the Orange Judd Publishing Company, New York.

The "flake" or French spawn costs about three times as much as the "brick" or English spawn, and as it is so much whiter with mycelium than is the "brick" spawn, many believe that it is more potent and well worth the additional cost. "In spawning the beds," says Mr. Falconer, "I use two pounds of 'flake' spawn to plant the same space for which I would use five pounds of 'brick' spawn, and this gives a capital crop, with the number of mushrooms a little in favor of 'flake' spawn; but on account of the larger size of the mushrooms the weight of the crop is considerably in favor of the 'brick' spawn. I also find more certainty of a crop in the case of the 'brick' spawn than in the other." Mr. John F. Barter, of Lancefield street, London, one of the most successful mushroom-growers and spawn-makers in Great Britain, who makes his living by it, in response to my inquiry, writes: "I have tried them both, and know 'brick' spawn to be far the better. Generally the French spawn produces one-third fewer mushrooms than does the 'brick' spawn from the same length of bed, and besides, those from the 'brick' spawn are by far the heavier and fleshier."

Mr. Falconer observes further that it is odd, but true, that the "flake" spawn does not produce as good results in outdoor beds as it does in those under cover.

#### VALUE OF MUSHROOMS AS A FOOD PRODUCT.

In Russia, Germany, Italy, and the south of France, mushrooms furnish the peasantry and frequently the working classes in the cities a food which in their case takes in part the place of meat, of which they are too often deprived.

According to Schlossberger and Depping, in 100 grams of dried mushrooms they found the following proportions of nitrogenous substances:

Varieties.	Grains.
Chanterelles .....	3.22
Certain Russulas .....	4.25
Lactarius deliciosus .....	4.68
Boletus edulis .....	4.25
Meadow mushroom .....	7.26

But all chemists are not agreed as to these proportions. For instance, Lefort has found 3.51 grains of nitrogenous matter in the cap of *Agaricus campestris*, 2.1 grains in the gills and only 0.34 of a grain in the stem. Payen has found 4.68 grains in *Agaricus campestris*, 4.4 grains in the common Morelle (*Morchella esculenta*), 9.96 grains in the white truffle, and 8.76 grains in the black.

The use of mushrooms exclusively for food is perfectly compatible with the preservation of excellent health, it is said. A number of

investigators have experimented in this line, nourishing themselves exclusively for weeks and months upon mushrooms and, it is said, have never enjoyed better health. A mountaineer of Thuringia, according to a legend of the foreign mycologists, lived upon mushrooms and nothing else for thirty years and died a centenarian (Dr. Gautier).

The same writer relates that a proprietor at Montagne, France, had from a cave, each day, an abundant crop of mushrooms, sometimes sending to market more than 400 pounds of them. There are in this cave between six and seven miles of mushrooms, and this proprietor is but one of a number of manufacturers devoted to this species of horticulture. The temperature of these caves is so equable that mushrooms may be cultivated in them the year round. Their best crops are said to be in winter. "But these great manufacturers have not a monopoly of the cultivation of the meadow mushroom. Each of our readers may very easily procure a mushroom bed at very little expense and amply sufficient for the domestic use of his household. In order to maintain the fruitfulness of the bed it is well to water it with the water in which the mushrooms for the table have been pared and washed, and also to allow a few plants to wither on the stem, as these at maturity will scatter their spores around them. When the bed is exhausted fresh manure should be added. Spring and summer are the best seasons for constructing the beds. They are usually in full bearing at the end of one or two months."

In Geneva a very lucrative trade is carried on in the exportation of the edible *Boletus*, which is preserved for use in various ways, the simplest of which consists in cutting the caps in slices and stringing them, after which they are placed on hurdles in the shade to dry. They may also be dried in a stove or oven but the former method is preferable, as the mushroom then retains more of its flavor or perfume. When the slices are perfectly dried they are put into sacks and suspended in a dry, airy place. Sometimes before the mushrooms are sliced they are plunged into boiling water for an instant, which treatment is said to preserve them from the ravages of insects. Several kinds of mushrooms are preserved in the following manner: After they have been properly washed and cleansed, they are boiled in salted water and afterwards wiped dry. They are then placed in layers, in jars, sprinkled with salt and pepper, and covered with pure olive oil or vinegar. *Lactarius deliciosus*, *Cantharellus cibarius*, *Morchellas*, *Clavarias*, etc., are thus preserved. Before using the dried mushrooms they are soaked in tepid water for some time and afterwards prepared as if fresh, with the usual seasoning.

#### DISTINGUISHING THE EDIBLE SPECIES.

Up to the present time, according to one European authority of recent date, it has been impossible to establish fixed and certain rules for distinguishing edible species of mushrooms from those that are poison-

ous. In general, all those should be regarded as suspicious whose flesh changes to a blue or greenish color on contact with the air, as should also those having a disagreeable, nauseating, or bad odor, or of which the taste is acrid and biting, or the flesh soft, deliquescent, spongy, hard, or corky. On the contrary, the flesh of edible mushrooms is usually firm, but tender, exhaling an odor of freshly ground meal. The aromatic principle which these mushrooms possess in the fresh condition disappears in part by drying them. But these characteristics alone should never serve as a guide for distinguishing edible mushrooms. Other generic and specific features of the plant must be taken into account if we would avoid errors.

#### PRESERVING AND COOKING MUSHROOMS.

In Europe several species of mushrooms are preserved by boiling and afterwards placing them in earthen jars or tubs filled with water, which is renewed from time to time. This simple and economical method of keeping mushrooms affords the people considerable provision. As to methods of preparing fresh mushrooms for table use, we confine ourselves to a few general directions borrowed from the excellent work of Dr. Roques:

Each country has its processes or special methods, but there are some which are more or less suitable according to the species of mushroom to be eaten. These plants are generally of a compact nature, requiring prolonged digestion. After selecting good mushrooms remove the skin or epidermis, cutting away the hymenium (gills) and in some cases the stem, which is usually of not so fine a texture. They are then allowed to soak for a time in cold or tepid water with the addition of a small quantity of salt and vinegar. After they have been carefully wiped, they are cooked simply on the gridiron and served with butter, pepper, and salt. This is the easiest and most economical method of preparing them. The flavor of the mushroom may be heightened by the addition of olive oil, fine herbs, a pinch of garlic, and some citron juice. This seasoning, much favored in the provinces of southern Europe, renders the mushrooms more healthful and more easily digested. According to species, mushrooms may be prepared with cream, in a fricassee of chicken or a matelote (dish of many kinds of fish), or in pies, soup, fritters, etc. After seasoning them in this case with pepper and salt as usual, they are rubbed in fresh butter and basted from time to time with citron juice, Madeira wine, or other white wine of good quality. Prepared in this way the "true orange" (*Amanita cæsarea*) and the "Cepe" (*Boletus edulis*) are delicious dishes.

Mushrooms should not be gathered during a rainy spell if desired for drying purposes, since their consequent state of humidity hastens their decomposition. It is important to select for use only young and well-preserved specimens, because a mushroom of excellent quality may, nevertheless, when overmature or near its decline, become dangerous for food. It then acts as every other food substance which incipient decomposition has rendered acrid, irritating, and indigestible. It is, moreover, rarely the case that mushrooms in their decline are not changed by the presence of larvæ. (Roques, Hist. des Champignons.)

## RECIPES.

The following recipes may prove useful to those not familiar with methods of cooking mushrooms.

*Broiled procerus.*—Remove the scales and stalks from the agarics and broil lightly on both sides over a clear fire for a few minutes; arrange them on a dish over freshly made, well-buttered toast; sprinkle with pepper and salt and put a small piece of butter on each; set before a brisk fire to melt the butter, and serve quickly. Bacon toasted over mushrooms improves the flavor and saves the butter.

*Agarics delicately stewed.*—Remove the stalks and scales from young, half-grown agarics, and throw each one as you do so into a basin of fresh water slightly acidulated with the juice of a lemon or a little good vinegar. When all are prepared remove them from the water and put them in a stewpan with a very small piece of fresh butter. Sprinkle with pepper and salt and add a little lemon juice; cover up closely and stew for half an hour; then add a spoonful of flour with sufficient cream, or cream and milk, till the whole has the thickness of cream. Season to taste and stew again until the agarics are perfectly tender. Remove all the butter from the surface and serve in a hot dish garnished with slices of lemon. A little mace or nutmeg or catsup may be added, but some think that spice spoils the flavor.

*Cottager's procerus pie.*—Cut fresh agarics in small pieces; pepper, salt, and place them on small shreds of bacon, in the bottom of a pie dish; then put in a layer of mashed potatoes, and so fill the dish, layer by layer, with a cover of mashed potatoes for the crust. Bake well for half an hour and brown before a quick fire.

*À la provençale.*—Steep for two hours in some salt, pepper, and a little garlic; then toss them in a small stewpan over a brisk fire with parsley chopped and a little lemon juice. (Dr. Badham).

*Agaric catsup.*—Place the agarics of as large a size as you can procure, layer by layer, in a deep pan, sprinkling each layer as it is put in with a little salt. Then next day stir them well several times so as to mash and extract their juice. On the third day strain off the liquor, measure and boil for ten minutes, and then to every pint of liquor add half an ounce of black pepper, a quarter of an ounce of bruised ginger root, a blade of mace, a clove or two, and a teaspoonful of mustard seed. Boil again for half an hour; put in two or three bay leaves and set aside till quite cold. Pass through a strainer and bottle; cork well and dip the ends in resin. A very little Chile vinegar is an improvement and some add a glass of port wine or a glass of strong ale to every bottle. Care should be taken that the spice is not so abundant as to overpower the true flavor of the agaric. A careful cook will keep back a little of the simple boiled liquor to guard against this danger.

*To stew mushrooms.*—Trim and rub clean half a pint of large button mushrooms. Put into a stewpan 2 ounces of butter; shake it over a fire until thoroughly melted; put in the mushrooms, a teaspoonful of salt, half as much pepper, and a blade of mace pounded; stew until the mushrooms are tender, then serve on a hot dish. This is usually a breakfast dish.

*Mushrooms à la crème.*—Trim and rub half a pint of button mushrooms; dissolve in a stewpan 2 ounces of butter rolled in flour; put in the mushrooms, a bunch of parsley, a teaspoonful of salt, half a teaspoonful each of white pepper and of powdered sugar; shake the pan for ten minutes; then beat up the yolks of two eggs with two tablespoonfuls of cream, and add by degrees to the mushrooms; in two or three minutes you can serve them in sauce.

*Mushrooms on toast.*—Put a pint of mushrooms into a stewpan with 2 ounces of butter rolled in flour; add a teaspoonful of salt, half a teaspoonful of white pepper, a blade of powdered mace, and half a teaspoonful of grated lemon; stew until the butter is all absorbed; then serve on toast, as soon as the mushrooms are tender.

*To pot mushrooms.*—The small open mushrooms suit best for potting. Trim and rub them; put into a stewpan a quart of mushrooms, 3 ounces of butter, two teaspoonfuls of salt, and half a teaspoonful of cayenne and mace mixed, and stew for ten or fifteen minutes or till the mushrooms are tender; take them carefully out and drain them perfectly on a sloping dish and when cold press them into small pots and pour clarified butter over them, in which state they will keep for a week or two. Writing paper over the butter and over that melted suet will effectually preserve them for weeks if in a dry, cool place.

*To pickle mushrooms.*—Select a number of small sound pasture mushrooms as nearly alike as possible in size. Throw them for a few minutes into cold water, then drain them, cut off the stalks and gently rub off the outer skin with a moist flannel dipped in salt; then boil the vinegar, adding to each quart 2 ounces of salt, half a nutmeg grated, a dram of mace, and an ounce of white pepper corns. Put the mushrooms into the vinegar for ten minutes over the fire; then pour the whole into small jars, taking care that the spices are equally divided; let them stand a day; then cover them.

*Baked mushrooms.*—Peel the tops of twenty mushrooms; cut off a portion of the stalks and wipe them carefully with a piece of flannel dipped in salt. Lay the mushrooms in a tin dish, put a small piece of butter on the top of each, and season with pepper and salt. Set the dish in the oven and bake them from twenty minutes to half an hour. When done arrange them high in the center of a very hot dish, pour the sauce around them, and serve quickly and as hot as you possibly can.

*Mushrooms with bacon.*—Take some full-grown mushrooms and having cleaned them procure a few rashers of nice streaky bacon and fry it in the usual manner. When nearly done add a dozen or so of mushrooms

and fry them slowly until they are cooked. In this process they will absorb all the fat of the bacon, and with the addition of a little salt and pepper will form a most appetizing breakfast relish.

*Mushrooms en ragout*.—Put into a stewpan a little “stock,” a small quantity of vinegar, parsley, and green onions chopped up, salt and spices. When this is about to boil, the cleaned mushrooms are put in. When done remove them from the fire and thicken with yolks of eggs.

#### CULTIVATION OF MUSHROOMS IN JAPAN.

The Japanese are very successful in cultivating a mushroom which they call “Shiitake” or “*Lepiota shiitake*.” China also produces the same mushroom but of an inferior quality. The Chinese therefore prefer the mushroom cultivated by the Japanese, which they import from Japan in large quantities. It is cultivated on a variety of trees, but is said to grow best on the “Shiinoki,” a species of oak (*Quercus cuspidata*).

There are three varieties of “Shiitake,” the spring, summer, and autumn crops, differing somewhat in quality. The method of growing the “Shiitake” is given by the Japanese Commissioner of Agriculture, as follows:

Trees of from twenty to fifty years growth are cut down at the approach of winter when the sap has ceased to run, and after the lapse of twenty or thirty days, according to the condition of the drying of the wood, are sawed into logs 4 or 5 feet in length. Into each of these logs incisions are made with a hatchet, at intervals of about 6 inches, and they are piled regularly upon a framework erected at a height of about 1 foot above the ground, under the trees. The location of the ground selected for piling the logs should be the slopes of a forest, facing southeast or southwest. After keeping the logs as above described for from two to three years, they are immersed in water for twenty-four hours in the middle of November, and again laid one upon another for about four days; if it is a cold district, the pile is covered with straw or mats. At the expiration of the fourth day the logs are obliquely tilted against poles fixed horizontally to the trees at a height of about 4 feet in a well ventilated and sunny situation. The mushrooms soon appear in quantity, and, after twenty or thirty days’ growth, are ready for harvesting.

Recent reports of the Japanese Agricultural Department show the total value of the annual export of “Shiitake” to be nearly five hundred thousand “yen” (silver). The value of a silver “yen” is 73 cents.

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[Extract from a letter of a correspondent in Virginia.]

\* \* \* I learned so much from your “Twelve Edible Mushrooms” that I wish to express my gratitude for the book and for the clear and distinct instructions you have put in it. I brought my little book down here this fall where people knew of only one edible mushroom. By your aid we discovered others, especially the Giant Puff-ball, which we gathered in great quantities and prepared in more than one fashion for the table, making an excellent addition to the somewhat limited bill of fare found in a country district.



## EDIBLE MUSHROOMS OF THE UNITED STATES.

### I. HYMENOMYCETES.

AGARICUS, Linnæus.

AMANITA, Fries.

Cæsareus, Fries.

Circinatus, Schumacher.

rubescens, Persoon.

strobiliformis, Vittadini.

vaginatus, Bulliard.

LEPIOTA, Fries.

cepæstipes, Sowerby.

var. cretaceus, Peck.

excoriatus, Schaeffer.

farinosus, Peck.

mastoides, Fries.

naucinoides, Peck.

procerus, Scopoli.

rachodes, Vittadini.

ARMILLARIA, Fries.

melleus, Vahl.

TRICHOLOMA, Fries.

albellus, De Candolle.

castus, Curtis.

Columbetta, Fries.

consociatus, Curtis.

frumentaceus, Bulliard.

gambosus, Fries.

hypopithus, Curtis.

imbricatus, Fries.

nudus, Bulliard.

personatus, Fries.

transmutans, Peck.

Russula, Schaeffer.

vaccinus, Persoon.

CLITOCYBE, Fries.

cespitosus, Curtis.

cyathiformis, Bulliard.

dealbatus, Fries.

fragrans, Sowerby.

geotropus, Bulliard.

giganteus, Sowerby.

gilvus, Persoon.

infundibuliformis, Schaeffer.

media, Peck.

nebularis, Batsch.

odorus, Bulliard.

COLLYBIA, Fries.

esculentus, Jacquin.

radicatus, Relhan.

PLEUROTUS, Fries.

dryinus, Persoon.

glandulosus, Fries.

ostreatus, Bulliard.

petaloides, Bulliard.

Pometi, Fries.

salignus, Persoon.

sapidus, Kalchbrenner.

tessulatus, Bulliard.

ulmarius, Bulliard.

VOLVARIA, Fries.

bombycinus, Schaeffer.

ENTOLOMA, Fries.

frumentaceus, Bulliard.

CLITOPILUS, Fries.

abortivus, Berkeley and Curtis.

orcella, Bulliard.

prunulus, Scopoli.

PHOLIOTA, Fries.

mutabilis, Schaeffer.

præcox, Persoon.

squarrosus, Müller.

PSALLIOTA, Fries.

amygdalinus, Curtis.

arvensis, Schaeffer.

campestris, Linnæus.

Rodmani, Peck.

silvicola, Vittadini.

squamosus, Fries.

HYPHOLOMA, Fries.

sublateritius, Fries.

COPRINUS, Fries.

atramentarius, Bulliard.

comatus, Fries.

CORTINARIUS, Fries.

(Dermocybe) cinnamomeus, Fries.

(Hygrocybe) castaneus, Fries.

(Inoloma) violaceus, Fries.

(Phlegmacium) cærulescens, Fries.

(Phlegmacium) turmalis, Fries.

(Telamonia) armillatus, Fries.

**PAXILLUS.**

*involutus*, Fries.

**HYGROPHORUS**, Fries.

*eburneus*, Bulliard.

*miniatus*, Fries.

*pratensis*, Persoon.

*virgineus*, Fries.

**LACTARIUS**, Fries.

*deliciosus*, Fries.

*insulsus*, Fries.

*piperatus*, Fries.

*subdulcis*, Bulliard.

*volemus*, Fries.

**RUSSULA**, Fries.

*alutacea*, Fries.

*heterophylla*, Fries.

*lepida*, Fries.

*rubra*, De Candolle.

*virescens*, Schaeffer.

**CANTHARELLUS**, Fries.

*cibarius*, Fries.

**MARASMIUS**, Fries.

*alliaceus*, Jacquin.

*oreades*, Bolton.

*scorodonius*, Fries.

**PANUS**, Fries.

*conchatus*, Fries.

*torulosus*, Persoon.

**BOLETUS**, Fries.

*badius*, Fries.

*bovinus*, Linnæus.

*castaneus*, Bulliard.

*Clintonianus*, Peck.

*collinitus*, Fries.

*edulis*, Bulliard.

*elegans*, Bulliard.

*flavidus*, Fries.

*granulatus*, Linnæus.

*luteus*, Linnæus.

*scaber*, Fries.

*subluteus*, Peck.

*subtomentosus*, Linnæus.

*versipellis*, Fries.

**POLYPORUS**, Fries.

*Berkeleyi*, Fries.

*confluens*, Albertini and Schweinitz.

*cristatus*, Persoon.

*frondosus*, Fries.

*giganteus*, Persoon.

**POLYPOROUS**, Fries—Continued.

*leucomelas*, Persoon.

*ovinus*, Schaeffer.

*picipes*, Fries.

*poripes*, Fries.

*squamosus*, Hudson.

*sulfureus*, Bulliard.

**FISTULINA**, Bulliard.

*hepatica*, Hudson.

**HYDNUM**, Linnæus.

*auriscalpium*, Linnæus.

*caput-Medusæ*, Bulliard.

*coralloides*, Scopoli.

*crinaceum*, Bulliard.

*imbricatum*, Linnæus.

*revigatum*, Sowerby.

*repandum*, Linnæus.

*rufescens*, Persoon.

*subsquamosum*, Batsch.

**CRATERELLUS**, Fries.

*cornucopioides*, Linnæus.

**SPARASSIS**, Fries.

*crispa*, Fries.

*laminosa*, Fries.

**CLAVARIA**, Linnæus.

*amethystina*, Bulliard.

*aurea*, Schaeffer.

*botrytis*, Persoon.

*cinerea*, Bulliard.

*cristata*, Persoon.

*fastigiata*, Linnæus.

*flava*, Schaeffer.

*formosa*, Persoon.

*fuliginea*, Persoon.

*grisea*, Persoon.

*macropus*, Persoon.

*muscoides*, Linnæus.

*pistillaris*, Linnæus.

*pyxidata*, Persoon.

*rugosa*, Bulliard.

*subtilis*, Persoon.

*tetragona*, Schweinitz.

*vermiculata*, Scopoli.

**TREMELLA**, Fries.

*lutescens*, Persoon.

*mesenterica*, Retz.

**HIRNEOLA**, Fries.

*auricula-Judæ*, Linnæus.

**II. GASTEROMYCETES.****BOVISTA**, Dillenius.

*nigrescens*, Persoon.

*plumbea*, Persoon.

**LYCOPERDON**, Tournefort.

*cælatum*, Bulliard.

**LYCOPERDON**—Continued.

*cyathiforme*, Bosc.

*giganteum*, Batsch.

*saccatum*, Fries.

*Wrightii*, Berkeley and Curtis.

## III. ASCOMYCETES.

**MORCHELLA**, Dillenius.  
*angusticeps*, Peck.  
*bispora*, Sowerby.  
*Caroliniana*, Bosc.  
*deliciosa*, Fries.  
*esculenta*, Persoon.  
*semilibera*, De Candolle.  
**HELVELLA**, Linnæus.  
*crispa*, Fries.  
*elastica*, Bulliard.  
*esculenta*, Linnæus.  
*infula*, Schaefter.  
*lacunosa*, Afzelius.  
*sulcata*, Afzelius.

**VERPA**, Swartz.  
*digitaliformis*, Persoon.  
**LEOTIA**, Hill.  
*lubrica*, Persoon.  
**PEZIZA**, Linnæus.  
*acetabulum*, Linnæus.  
*aurantia*, Fries.  
*badia*, Persoon.  
*cochleata*, Hudson.  
*macropus*, Persoon.  
*onotica*, Persoon.  
*vesiculosa*, Bulliard.  
**BULGARIA**, Fries.  
*inquinans*, Fries.

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U. S. DEPARTMENT OF AGRICULTURE.  
DIVISION OF MICROSCOPY.

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FOOD PRODUCTS.—III.

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IMPROVED METHODS OF DISTINGUISHING BETWEEN  
PURE AND FICTITIOUS LARD.

AND FOUR EDIBLE MUSHROOMS OF THE UNITED STATES.

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BY

THOMAS TAYLOR, M. D.,  
CHIEF OF THE DIVISION OF MICROSCOPY.

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### INTRODUCTORY NOTE.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF MICROSCOPY,  
*Washington, D. C., September 22, 1893.*

**SIR:** The accompanying papers from my report for the year 1891 are respectfully submitted, with the request that they be repinted in order to facilitate compliance with the requests of correspondents.

Very respectfully,

THOMAS TAYLOR,  
*Microscopist.*

Hon. J. STERLING MORTON,  
*Secretary of Agriculture.*

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## IMPROVED METHODS OF DISTINGUISHING BETWEEN PURE AND FICTITIOUS LARD.

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The following preliminary statement of experiments has been prepared in consideration of the many requests received in this division for information which will enable one skilled in the use of the microscope to distinguish pure lard from fictitious lard:

(1) Heat, over the flame of a Bunsen burner, in a porcelain capsule, 4 ounces of pure home-rendered leaf lard, for a period of one minute, and allow it to cool slowly until it solidifies, which will require a period of about four hours, in an atmosphere of about 75° F. The crystalline groupings of this sample will appear very small when viewed under a power of 100 diameters.

(2) Prepare, in like manner, another sample of pure leaf lard, heating it for a period of four minutes, and allowing it to cool slowly, as above. It will be observed that pure lard in this case shows well-defined crystals of stearin, viewed under the microscope as above, and will, without regard to the high temperatures to which it has been exposed, consolidate in about the time given in the first experiment.

(3) Prepare a sample of compound lard, consisting of commercial stearin and sufficient cotton-seed oil to bring the stearin to the consistency of good pure lard; heat four minutes, and cool slowly. It will consolidate in about an hour, at 75° F.

(4) Prepare a second sample of compound lard, consisting principally of commercial stearin to which a trace of pure lard has been added; heat this compound for a period of four minutes. This compound will also consolidate quickly, owing to the presence of stearin in large quantity.

(5) Prepare a third sample of compound lard, consisting of commercial stearin, oleo, and cotton-seed oil, with a trace of pure lard; heat four minutes, and allow it to cool slowly, at 75° F. In this case it will be observed that the time required for consolidation will depend upon the amount of stearin present.

(6) Prepare a sample of commercial oleo after the method of the first experiment. This, like pure lard, will require about four hours, at 75° F., to consolidate.

(7) Prepare a sample of commercial stearin, heating it four minutes. This will consolidate in about half an hour or less, at the temperature given above.

Some samples of compound lard are very deceptive in appearance, being smooth and translucent, especially such as are composed of lard and oleo, but these are easily detected by the use of the microscope and polarized light. My usual practice is, first, to examine each sample with the unaided eye, compressing a portion of the lard about the size of a large pin head between two pieces of clear glass about 1 inch square each, and holding each sample up to the light to compare it with a sample of home-rendered lard similarly prepared. As fictitious lard contains a large amount of stearin, it will exhibit by this method of examination many white spots, which represent the crystallized stearin, and which are not seen in pure lard. The amount of natural

stearin in pure lard is so small that it is not visible to the unaided eye by this method of examination; therefore the microscope should be used in the examination of pure lard, as the groupings of the crystallized fats of lard are very small. These groupings are in stellar forms, composed of spicules which proceed from a common center, frequently requiring to be magnified 400 times to discern them, while the groupings of branched crystals of stearin are easily observed to advantage under a power of 100 diameters.

Stearin constitutes one of the principal fats of fictitious lard. It gives firmness to the other fats and is less soluble than palmitin. It is the first to crystallize when held in solution with other fats. Its branched groupings are easily resolvable under the microscope, and always appear very bright by polarized light. Taking advantage of these facts, I heat, say, 4 ounces of a suspected lard in any suitable vessel, over the flame of a Bunsen burner. If the sample hardens quickly in a temperature of about  $75^{\circ}$  F., it will be found to contain a large amount of stearin. A sample, on the other hand, consisting principally of either pure lard or oleo, or of a mixture of these two, will consolidate very slowly as compared with a sample to which a large proportion of commercial stearin has been added. The first fumes which arise in the heating process will indicate somewhat the composition of the fat. If it contains a large amount of leaf or other lard, the lard odor will be easily recognized. If the sample contains only a trace of lard, the lard odor will be evanescent. If very acrid fumes arise during the heating process, producing a tendency to cough on the part of the observer, the presence of cotton-seed oil is indicated.

The two commercial solid fats which enter largely into compound lard, as at present manufactured, are commercial stearin and oleo, to which is generally added cotton-seed oil for the purpose of reducing the stearin to the consistency of pure home-rendered lard.

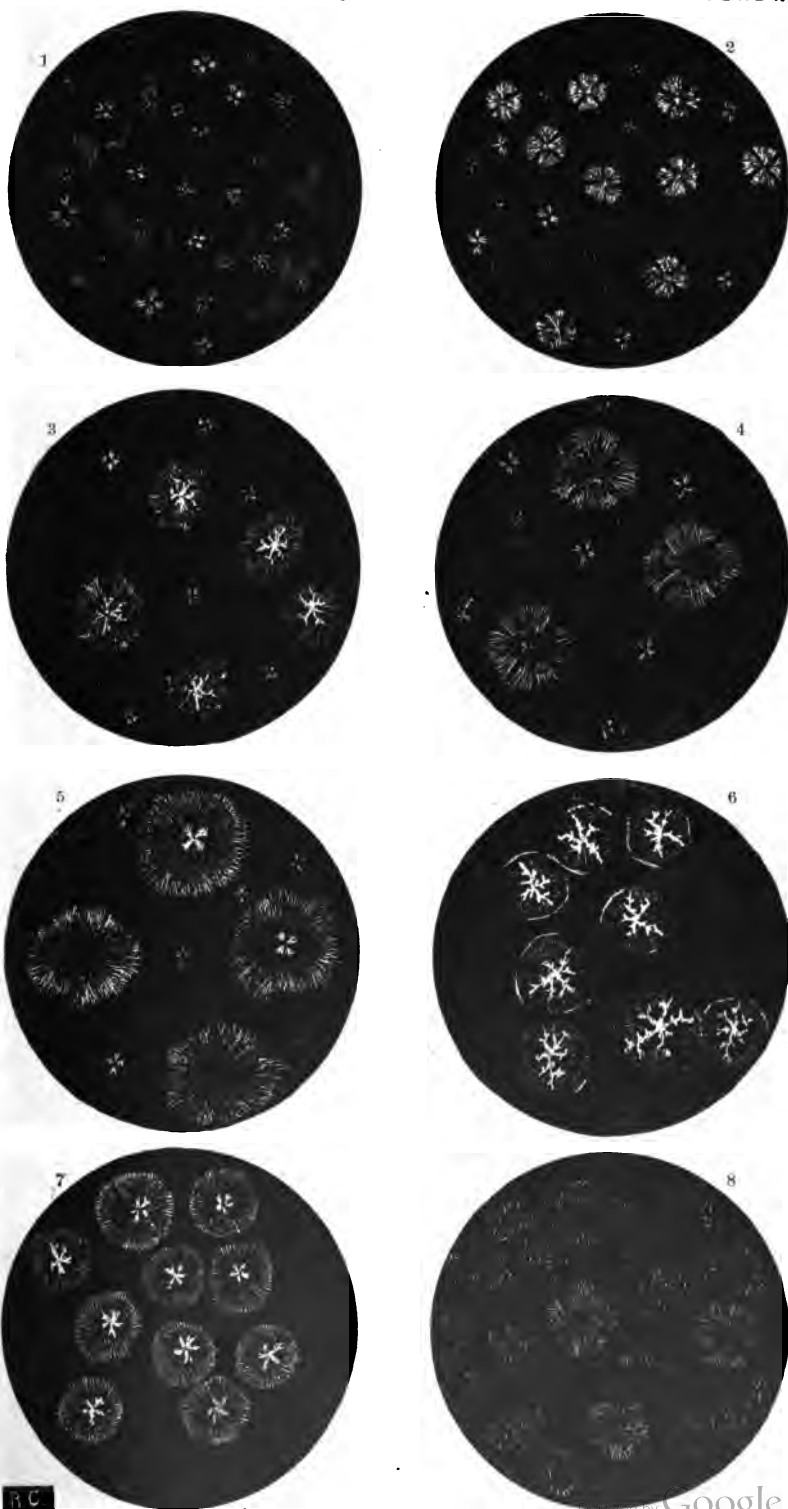
#### EXPLANATION OF PLATE I.

Plate I represents the various crystalline forms of pure leaf lard, lard compounds, and compound fats sold as lard. Figs. 1, 2, and 8, crystalline forms of pure leaf lard; Fig. 3, a compound of stearin, oleo, and cotton-seed oil; Fig. 4, a compound of lard and oleo; Fig. 5, stearin, oleo, and cotton-seed oil; Fig. 6, stearin, cotton-seed oil, and a trace of palmitin; Fig. 7, stearin, oleo, and cotton-seed oil.

Samples 3, 5, 6, and 7 are varied in their proportions of stearin, oleo, and cotton-seed oil. When stearin is in excess in one of these compounds it appears in very bright, branching crystals in the center of each mass of crystallized palmitin. All fictitious lards abound in stearin. On being highly heated and cooled slowly in a temperature of about  $75^{\circ}$  the stearin, being less soluble than the palmitin fat, crystallizes first; the palmitin next crystallizes over the branching stearin crystals.

Viewed under polarized light with dark ground, the compositions of the respective fats, stearin and palmitin, are at once distinguished one from the other. The cotton-seed oil, although a fat, is not observed under the microscope, as it does not crystallize at ordinary temperatures.

Pure lard, unless highly heated, exhibits a dull crystalline appearance as compared with stearin, as it consists mostly of palmitin and oil, with but a trace of stearin.



PURE LARD AND FICTITIOUS LARD.

1, 2, and 8, pure lard; 3, 5, and 7, stearin, oleo, and cotton-seed oil; 4, lard and oleo; 6, stearin.



## FOUR EDIBLE MUSHROOMS OF THE UNITED STATES.

---

In the present paper, as well as in my former papers relating to poisonous and edible mushrooms, I have endeavored in my descriptions of species to employ terms which are in common use in all English-speaking countries, giving at the same time their scientific equivalents. As this method is not always a convenient one, and as the need of a glossary of terms relating to fungi has been urged frequently by students of the subject, such a glossary has been appended to this paper. To facilitate the study of the structural forms of the mushroom group, moreover, a plate is inserted, which consists of sectional drawings showing the diverse forms of the mushroom cap, the gills, and the stalk. The requests of many correspondents leave no room to doubt that both glossary and plate will be appreciated. The colored illustrations will also be found helpful, it is believed, in enabling those who are not possessed of botanical skill to distinguish species.

### THE CULTIVATION OF MUSHROOMS.

The successful cultivation of mushrooms on a large scale is carried on in many places throughout Europe and especially in Great Britain. Mr. John F. Barter, of London, England, who is considered the largest mushroom-grower in Great Britain, wrote to a friend in the United States that he marketed during the season of 1889-'90 11 tons of mushrooms, and during the season of 1890-'91 about 10 tons. In a meritorious treatise on Mushroom Culture for Pleasure and Profit, by Mr. William Falconer, of New Jersey, the author remarks:

In the most prosperous and progressive of all countries, with a population of nearly 70,000,000 of people alert to every profitable legitimate business, mushroom-growing, one of the simplest and most remunerative of industries, is almost unknown. Mushrooms and their extensive and profitable culture should concern every one.

For home consumption they are a healthful and grateful food, and when successfully grown for market they become a most profitable crop. No one can grow mushrooms better nor more economically than the farmer. He has already the cellar room, the fresh manure, and the loam, and all he needs is some spawn with which to plant the beds. Nothing is lost. The manure after having been used in mushroom beds is not exhausted of its fertility, but instead is well rotted and in a better condition to apply to the land than it was before being used for the mushroom crop. The farmer will not feel the little labor it takes. There is no secret whatever connected with it, and skilled labor is unnecessary to make it successful. The commonest farm hand can do the work, which consists of turning the manure once every day or two, for about three weeks, and then building it into a bed and spawning

and covering it with mold. Nearly all the labor for the next ten or twelve weeks consists in maintaining an even temperature and gathering and marketing the crop.

Many women are searching for remunerative and pleasant employment on the farm, and what can be more interesting, pleasant, and profitable work for them than mushroom-growing? After the farmer makes up the mushroom bed, his wife or daughter can attend to its management with scarcely any tax upon her time and without interfering with her other domestic duties. And it is clean work; there is nothing menial about it. No lady in the land would hesitate to pick the mushrooms in the open field; how much less, then, should she hesitate to gather the fresh mushrooms from the clean beds in her own clean cellar. Mushrooms are a winter crop; they come when we need them most. The supply of eggs in the winter season is limited enough and pin money often proportionately short; but with an insatiable market demand for mushrooms all winter long at good prices, no farmer's wife need care whether the hens lay eggs at Christmas or not. When mushroom-growing is intelligently conducted there is more money in it than in hens, and with less trouble.

There are those who venture to assert, as will be seen from the following paragraph from Hardwick's Science Gossip, that the cultivation of mushrooms will eventually have an important bearing upon the world's food supply:

Occasionally we hear vegetarians say they live upon some fabulously small sum—a few pence per diem, and although very few people indeed would care to debar themselves of wholesome, nutritious food for the sake of a mere theory, yet it can not be overlooked that the continued and continuing increase of the population will eventually demand a full development of the resources of the country. There can not be a doubt that the esculent species of fungi will in the future occupy a most important place in the dietary of the nation, not simply because of their cheapness, but rather by reason of their nutritious qualities and the large proportion of nitrogenous compounds they contain.

#### METHODS OF MUSHROOM CULTURE.

The cellar of a dwelling house is a capital place for mushroom beds, and can be used in whole or in part for this purpose. In the case of private families, who wish to grow only a few mushrooms for their own use, it is not necessary to use the whole cellar; it will be sufficient to partition off a part of it with boards and make the beds in this, or to make a bed alongside of the wall anywhere and box it in to protect it from cold drafts and from mice and rats. Shelves may be placed above the bed for domestic purposes, just as in any other part of the cellar. Bear in mind that mushrooms thrive best in an atmospheric temperature of from 50° to 60° F., and if you can give them this in your house-cellar you ought to get plenty of good mushrooms. But if such a high temperature can not be maintained without impairing the usefulness of the cellar for other purposes, box up the bed tightly, and from the heat of the bed itself when thus confined there usually will be warmth enough for the mushrooms; but if there is not, spread a piece of old carpet or matting over the boxing.

The beds may be made upon the floor, flat or ridged, or banked against the wall, 10 or 12 inches deep in a warm cellar, and 15 to 20 inches or more deep in a cool cellar, and about 3 feet wide and any

length to suit. The boxing may consist of any kind of boards for sides and ends, and may be built about 6 or 10 inches higher than the top of the beds, so as to give the mushrooms plenty of head room. The top of the boxing may be a lid hung on hinges or straps, or otherwise arranged to admit of being easily raised or removed at will, and made of light lumber, say half-inch boards. In this way, by opening the lid, the mushrooms are under observation and can be gathered without any trouble. When the lid is shut they are secure from cold and vermin. Thus protected, the cellars can be ventilated without interfering with the welfare of the mushrooms. A light wooden frame, covered with calico or oiled paper, would also make a good top for the boxing, but would not be proof against much cold or against rats or mice. If desirable, shelf beds could be built in warm cellars above the floor beds, but in cool, airy cellars this would not be advisable. Manure beds in the dwelling-house cellar may seem highly improper to many people, but when rightly handled these beds emit no bad odor. The manure should be prepared away from the house, and when ready for making into beds should be spread out thin, so as to become perfectly cool and free from steam. When it has lain for two days in this condition, it may be brought into the cellar and made into beds. Having been well sweetened by previous preparation, it is now cool, free from steam, and almost odorless. After a few days it will warm up a little, and may then be spawned and earthed over at once. Do not bury the spawn in the manure; merely set it in the surface of the manure. This method prevents the spawn from being destroyed by too great heat should the bed become unduly warm. If the manure has been well prepared, however, this is not likely to occur. The coating of loam prevents the escape of any further steam or odor from the manure.

On the 14th of January last Mr. W. Robinson, editor of the London Garden, in writing to Mr. William Falconer mentioned the following very interesting case of growing mushrooms in the cellar of a dwelling house:

I went out the other day to see Mr. Horace Cox, the manager of the Field newspaper, who lives at Harrow, near the famous school. His house is heated by a hot-water system called Keith's, and the boiler, which is a very simple one, is in a chamber of the house in the basement. I went down to see it worked with coke refuse. However, I was pleased to see all the floor of the room not occupied by the boiler covered with little flat mushroom-beds and bearing a very good crop. Truth to tell, I used to fear that growing mushrooms in dwelling houses might be objectionable in various ways, but this instance is very interesting, as there is not even the slightest unpleasant smell in the chamber itself. The beds are small, scarcely a foot high, and perfectly odorless, so that it is quite clear that one may cultivate mushrooms in one's house in such a case as this without the slightest offense. A bed has been known to begin bearing early in November and to bear a good crop until the 1st of May.

Mr. Denton, a market gardener, about 10 miles from New York on Long Island, uses both French and brick spawn. He markets from 1,700 to 2,500 pounds of mushrooms a year from his two cellars. Every summer he cleans out his cellars and lime-washes them all over. He ascribes his success to thorough cleaning.

## CULTIVATION OF MUSHROOMS ON THE CONTINENT OF EUROPE.

As regards the cultivation of mushrooms on the continent of Europe, I briefly summarize from a late Italian author various methods for the benefit of our readers.

A way at once easy and simple of raising mushrooms perennially is to dig a trench 2 feet wide by 6 inches deep and of length proportionate to the extent of ground, in a well sheltered garden having a southern or eastern exposure. Fill this trench with good horse manure that is larded with mushroom spawn, and cover with rich earth. Water the bed from time to time, frequently in summer, especially if a very hot season, and protect the bed from chilling by a cover of straw or the surplus manure. The mushroom bed may be made as well in a cave, with the advantage of requiring less care, the atmospheric temperature being generally equable.

A mushroom bed may be kept fruitful or productive by sprinkling it with water in which mushrooms have been washed and skinned before cooking, also by treading some mushrooms under foot upon the bed occasionally so that the spores may absorb its fertility. Another method is to mix the parings of mushrooms with good horse droppings and scatter this in shrubberies or gardens upon a soil previously worked with the mattock or spade.

Treatises on horticulture, generally, commend the laborious and expensive methods practiced by the kitchen gardeners of Paris, but, says Dr. Roques—\*

A sure method I owe to nature's teaching revealed by accident. All rich earth which is charged with the droppings of our domesticated animals, especially of the bovine or ovine race, when half rotted and blanched by deprivation of air and sunlight, will produce an edible mushroom sooner or later. Market gardeners who have heaps of this fertilizer in reserve find mushrooms growing in it. If such half-rotted manure be placed in a dry cave or other dry and covered place it will spawn in a few weeks if not made too damp by injudicious watering. Gardeners who keep such a supply of rich mold on hand for a top-dressing for early onion, radish, and lettuce beds, etc., may thus obtain two crops for one, and gather their mushrooms without injury to the crop of other plants. The same results would follow if they should top-dress melon beds to the depth of 2 or 3 inches with this blanched manure. The crop thus obtained would well repay them, equally as well as the melon crop, without undervaluing the latter. I give this as my practical experience and not as gleaned from some book in a chimney corner.

It is said that Micheli sowed the spores of some gilled mushrooms on a heap of decomposing leaves of the scarlet oak and gathered a crop of mushrooms. The successful experiments of some later naturalists have repeated the experience of the Italian botanist. This goes to show a power of reproduction in the mushroom spore independent of the usual medium of rotted horse manure. Dr. Thore, in his "*Flore des Landes*," is authority for the statement that in that province the *Boletus edulis*

\*Quoted by Dr. Barla in his work on the Edible Mushrooms of Nice and its Environs, published with illustrations in 1859.

and *Russula virescens*, two choice varieties, are propagated by pouring out upon the ground in a shrubbery planted with oaks the water in which these two varieties have been boiled. No other care is required than to protect the plantation against the trespasses of horses, pigs, and horned cattle, which eat these plants with avidity. The method is said to be unfailing.

#### MYCELIUM OR SPAWN OF MUSHROOMS.

Although in my report "Food Products—H: Eight Edible and Twelve Poisonous Mushrooms of the United States," I have endeavored to explain at some length the terms mushroom "spawn" and mushroom "bricks" in answer to the inquiries for simple and easily understood explanations of the propagation of mushrooms for food and profit, yet since we continue to receive such inquiries and for the benefit of those who may not have seen the antecedent paper, I have deemed it desirable to add briefly some additional information on this subject. The mycelium of mushrooms or the mushroom spawn is usually white, but is also found yellow, and even red. It is distinguished by some writers as nematoid, fibrous, hymenoid, scleroid or tuberculous, and malacoid. The nematoid mycelium is the most common. Creeping along on the surface of the earth, penetrating it to a greater or less depth, developing in manure among the débris of leaves or decayed branches, always protected from the light, it presently consists of very delicate filamentous cells more or less loosely interwoven, divided, anastomosing in every direction and often of considerable extent.

Its presence is sometimes difficult to detect without the use of the microscope, either on account of its delicacy or because it is being intermingled with the organic tissues in which it has developed.

Sometimes mycelium unites in bundles more or less thick and branched. This has been called the fibrous mycelium. Where the filaments intercross closely, are felted, and inclined to form a membrane, it is hymenoid mycelium. Where the filaments are so small and close that they form very compact bodies, constituting those solid irregular products called sclerotium, it is scleroid or tuberculous mycelium. With malacoid mycelium we have nothing to do in this paper. It is a soft, pulpy, fleshy mycelium.

Dr. Leveillé has thus defined mycelium: "Filaments at first simple, then more or less complicated, resulting from the vegetation of the spores and serving as a support and root to the mushroom."

Italian writers are familiar with a substance called mushroom "stone," found in Naples and the environs. The *Polyporus tuberaster* grows upon it. It is simply a mass, of greater or less size, composed of earth, small stones, and the remnants of vegetation, united by a white, byssoid, abundant mycelium. It has been by some authors regarded as a species of volcanic tufa of an argillaceous and calcareous nature, but is nothing more than mycelium in which successive generations of this species of *Polyporus* have developed.

Although heat and humidity influence all kinds of vegetation, yet heat seems to exert less and humidity a greater influence on mushrooms than on other plants. It is chiefly during the cool, moist, autumnal weather that the fleshy mushrooms flourish most vigorously in the United States, one of the most fruitful countries known for this class of esculents. Rain falls copiously here in many places, hence it is a reasonable deduction that, as moisture is a condition favorable to the development of these plants, they will be plentiful.

#### FOUR EDIBLE SPECIES.

##### PLATE II.—*Agaricus melleus* Vahl. (Order *Agaricini*.)

Subgenus *ARMILLARIA* (little bracelet).—Veil partial, annular, hence the name from *armilla*, an armlet or bracelet, alluding to the ample persistent collar of the plant. Described by Bulliard as *Agaricus annularius*, by Decandolle as *A. annularis*, by Persoon as *A. polymyces*.

Cap fleshy, honey-colored or ochereous, striated on the margin, shaded with brown, darker towards the center, umbonate or umbilicate in full-grown specimens, tufted with dark-brown fugitive hairs. Color of the cap varies, depending upon climatic conditions and the character of the soil. Gills distant, ending in a decurrent tooth, pallid or dirty white, very often showing brown or rust-colored spots when old. Spores white and abundant. Stem elastic, scaly, 4 inches or more in length. Ring floccose. Diameter of cap from 2 to 5 inches. Manner of growth *cæspitose*, and, as with most of the *Armillarias*, generally parasitic on old stumps, although I found the group here figured growing on moist, sandy clay, on a roadside, in Hyndsboro Park, Md.

##### PLATE III.—*Agaricus deliciosus* Fr.

Subgenus *LACTARIUS* (milk-bearing).—Hence the name, from *lac*, milk, applied to the exudation from the gills, which in some of the species resembles cow's milk. *Deliciosus* refers to the agreeable flavor of the plant, which is one of the most remarkable of this group.

Cap fleshy, hemispherical, then convex, umbilicate in some adult specimens, funnel-shaped, marked in the adult plant with rings or zones of a ferruginous color. Color of the cap orange, varying in tint, growing paler and greenish when old or dried. Diameter from 2 to 6 inches. Gills decurrent, crowded, rather thick, sometimes slightly forked at the base, according to some French writers on mushrooms. Color of the gills pale orange, sometimes a saffron yellow, exuding when bruised a bright red or orange-colored liquid, hence often given the name, popularly, of the "orange-milk" mushroom. This liquid turns green on exposure to the atmosphere. Stem attenuated downward, smooth, and stuffed with a yellowish pith, then hollow, and finally brittle. Color about the same as the cap.

##### PLATE IV.—*Cantharellus cibarius* Fr.

This species is distinguished from an *Agaric*, which at first sight it resembles, by having veins instead of gills. It has been described by Linnæus as *Agaricus cantharellus*, by Bulliard under the same name, by Scopoli as *Merulius cantharellus*. Fries does not put it in the list of the *Agaricini*, while Berkeley classifies it under that order. The *chantarelle* takes its name from a Greek word signifying a cup or vase, referring to its shape and possibly also to its rich golden color. *Cibarius* refers to its esculent properties.

Cap a rich egg yellow, at first convex, later concave and turbinated. Margin sinuous-undulate, smooth, and more extended on one side than the other. Diameter



**AGARICUS (ARMILLARIA) MELLEUS.**

Group from Hynesboro Park, Md. U.S.





**AGARICUS (LACTARIUS) DELICIOSUS.**

1 General form. 2 Section. 3 Spores.





**CANTHARELLUS CIBARIUS FR.**

1, 2, 3, 4, Various stages of growth 5 A section.

6 Spores 7 Spores and basidia.

From Hynesbury, Md., U.S.





**FISTULINA HEPATICA.**

- 1 Specimen, upper view. 2 Same, under view.  
3 Specimen, upper view. 4 Same, under view.  
5 Spores.

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nearly 4 inches. Veins rather thick and wiry, markedly decurrent, usually bifurcated two or three times, and of the same color as the cap. Spores white. Stem stuffed, thicker above, tapering downward, and slightly curved at the base. Flesh white and firm, odor agreeable, flavor a little peppery. Found in the woods in groups in summer and in autumn.

PLATE V.—*Fistulina hepatica* Fr. (Order Polyporei.)

*Fistulina* refers to the form of its little tubes situated on the under surface of this mushroom, *hepatica* to its fancied resemblance when old to a piece of liver. It is also called beef's tongue, which it sometimes resembles, when young, in shape and color.

Cap of variable form, upper surface at first blood red, covered with papillæ, then red brown, and finally a very dark red. Flesh fibrous, juicy, and mottled. Flavor acid, odor agreeable. Tubes at first short, then elongated, having fringed orifices, color whitish, turning brown when bruised. Sometimes found of quite-large size. One is mentioned as found in England weighing 30 pounds. Found in summer and autumn on oak and beech trees principally. In Italy its common name is said to be "oak tongue" or "chestnut tongue," and it is said to be equally good whether gathered from one or the other.

This mushroom is described by Schaeffer as *Boletus hepaticus*; Bulliard gives it as *Fistulina buglossoides*. Berkeley describes a "beautiful and interesting species, *A. (Pleurotus) subpalmatus* Fr.," as having the flesh mottled like that of *Fistulina hepatica*, and also gives the habitat of *Polyporus quercinus* as identical with the species represented in Pl. v. Figs. 1, 2, 3, and 4 of this plate represent the color and form of the upper and under surfaces of specimens collected near Falls Church, Va., where the species grows in profusion.

For most beautiful specimens of this and many other of our native mushrooms I am indebted to Mr. F. J. Braendle, Falls Church, Va.

## STRUCTURAL FEATURES OF VARIOUS ORDERS OF MUSHROOMS.

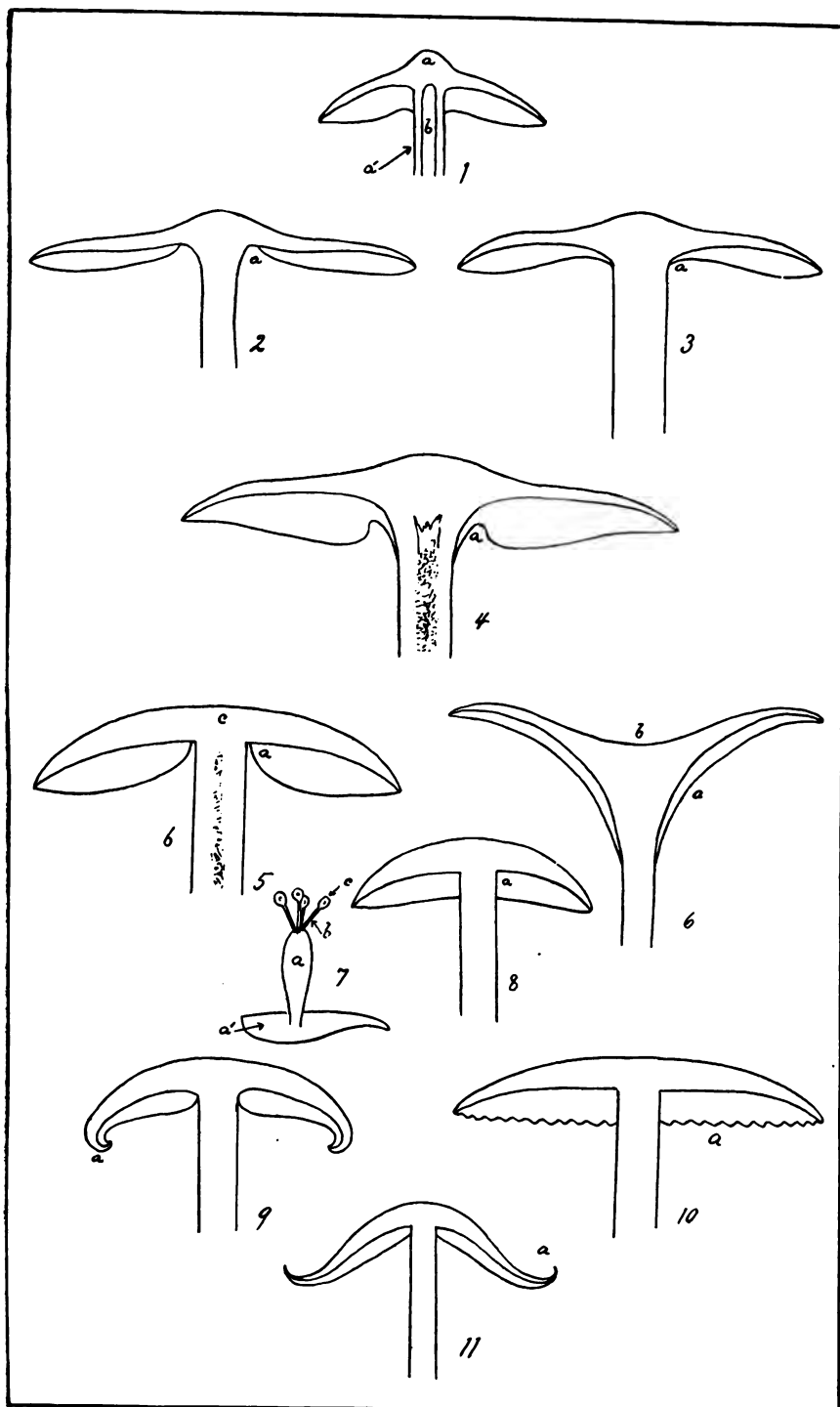
The structure of the gill-bearing mushrooms, or *Agaricini*, is shown in Plate VI, the description of which follows:

- Fig. 1. Cap or pileus umbonate, *a*; stem or stipe fistulose, *b*; gills or lamellæ adnate and slightly emarginate.
- Fig. 2. Gills remote, *i. e.*, distant from stem. (See *a*.)
- Fig. 3. Gills adnexed, just reaching the stem, as at *a*, but not attached to it.
- Fig. 4. Gills emarginate, with a tooth, as at *a*; stem stuffed.
- Fig. 5. Cap obtuse, *c*; gills free, *i. e.*, just reaching the stem but not attached to it. (See *a*.) *b*, stem stuffed.
- Fig. 6. Cap umbilicate, *b*; gills decurrent, *i. e.*, running down the stem. (See *a*.)
- Fig. 7. Basidium cell, *a*, borne on the hymenium or spore-bearing surface of the gills; *b*, stigmata; *c*, spores.
- Fig. 8. Gills adnate, *i. e.*, firmly attached to the stem at their inner extremity, as at *a*.
- Fig. 9. Cap with border involute, *i. e.*, rolled inward. (See *a*.)
- Fig. 10. Lamellæ or gills dentated or toothed. (See *a*.)
- Fig. 11. Cap with border revolute, *i. e.*, rolled backward. (See *a*.)

In the pore-bearing mushrooms, or *Polyporei*, the gills are replaced by tubes or pores. The tubes are little cylinders, long or short, pressed one against another, forming by their union a layer on the under surface of the cap and constituting the fructifying membrane in *Boleti*, the soft form of the order *Polyporei*. They also consist of the substance of the cap, and the sporiferous membrane or hymenium lines their inner walls. Their upper end is always closed, while the opposite extremity is open to permit the passage of the spores. The tubes are generally joined together, and may not be disunited unless they are torn apart. They are free in the sole genus *Fistulina*.

As regards their attachment to the cap they may be firmly adherent, as in *Polyporus*, or easily detached in a single mass, as in *Boletus*, the flesh of the latter being soft and tender. They frequently leave a circular space of greater or less dimensions around the stem or they adhere to or are prolonged upon it in such a manner that the orifices rise in tiers one above another. The color of the tubes, although not offering as characteristic varieties as that of the gills, changes nevertheless according to species and according to the age of the plant. The tubes may sometimes be of a different color from their orifices, as in *Boletus luridus*. In some *Boleti* the color of the flesh is changed on exposure to the air and the tubes often assume the same tints. The tubes generally called pores are sometimes closely adherent to the substance of the cap, which is commonly hard, corky, or coriaceous, as seen in most of the *Polyporei*.

The spines of the spine-bearing mushrooms, or *Hydnei*, are projecting conical elevations divided or entire, simple or ramified, having the appearance of points or spines, and are formed by the substance of the cap on the inner surface of which they are attached. The spines are



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clothed with the sporiferous membrane (*hymenium*) and are the seat of the organs of fructification in mushrooms of the genus *Hydnum*. In the early stages of development they look like little projecting points or papillæ, those on the margin of the cap and at the apex of the stem being always less developed, frequently remaining in this rudimentary state. They are rounded in *Hydnum imbricatum*, sometimes compressed in *Hydnum repandum*, sometimes terminating in hairs, as in *Hydnum barba Jovis*, or they may be very much divided, as in *Hydnum fimbriatum*.

In the *Auricularini* the hymenium is more or less even.

In *Clavariæ* the whole fungus is club-shaped or more or less intricately branched, with the hymenium covering the outer surface.

In the *Tremellini* we have a gelatinous substance and a great departure from the character of the substance, external appearance, and internal structure of the other orders in this family. The form is lobed, folded, convolute, often resembling the brain of some animal. It is uniformly composed throughout of a colorless mucilage with no appreciable texture, in which are distributed very fine, diversely branched, and anastomosing filaments. Towards the surface the ultimate branches of this filamentose network give birth to globular cells, both at their summits and laterally, which attain a comparatively large size. These cells are filled with a protoplasm, to which the plant owes its color. When they have obtained their normal dimensions they elongate at the summit into two, three, or four distinct, thick, obtuse tubes, into which the protoplasm gradually passes. The development of these tubes is by degrees; as each tube attains its full size it is attenuated into a fine point. Sometimes these tubes or spicules send out one or two lateral branches, each terminated by a spore. These spores are smooth and deposit themselves like a fine white dust on the surface of the Tremella and on its matrix.



## GLOSSARY OF TERMS USED IN DESCRIBING MUSHROOMS.

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- Abortive*, imperfectly developed.
- Acaulescent, acaulous*, having a very short stem or none.
- Acetabuliform*, cup-shaped.
- Acicular*, needle-shaped.
- Aculeate*, slender pointed.
- Acuminate*, terminating in a point.
- Acute*, sharp pointed.
- Adnate*, gills firmly attached to the stem.
- Adnexed*, gills just reaching the stem.
- Adpressed*, pressed in close contact, as applied to gills.
- Eruginous*, verdigris-green.
- Agglutinated*, glued to the surface.
- Aggregated*, collected together.
- Alveolate*, socketed or honey-combed.
- Amphigenous*, when the hymenium is not restricted to a particular surface.
- Analogy*, superficial or general resemblance without structural agreement.
- Anastomosing*, branching, joining of one vein with another.
- Annular*, ring-shaped.
- Annulate*, having a ring.
- Annulus*, ring round the stem of agarics.
- Apex*, in mushrooms the extremity of the stem nearest the gill.
- Apical*, close to the apex.
- Apiculate*, terminating in a small point.
- Appendiculate*, hanging in small fragments.
- Approximate*, of gills which approach the stem but do not reach it.
- Arachnoid*, cobweb-like.
- Arboreal, arboricle*, tree-inhabiting.
- Arcuate*, bow-shaped.
- Areolate*, divided into little areas or patches.
- Argillaceous*, clayey, like clay.
- Ascending*, directed upward.
- Asci, ascidia*, spore-cases of certain mushrooms.
- Attenuated*, tapering gradually to a point upward or downward.
- Band*, a broad bar of color.
- Banded*, marked with bands.
- Barbed*, furnished with fibrils or hairs.
- Basidia*, cellular processes of certain mushroom-bearing spores.
- Bibliography*, condensed history of the literature of a subject.
- Bifurcated*, divided into two, as in the gills of certain agarics.
- Booted*, applied to the stem of a mushroom when inclosed in a sheath or volva.
- Boss*, a knob or short rounded protuberance.
- Bossed, bullate*, furnished with a boss or knob.
- Branched*, dividing from the sides; also styled furcate and forked.
- Brick*, trade term for a mass of mushroom spawn, in dimensions the size of a brick of masonry.
- Broad*, wide or deep vertically.
- Bulbous*, having the structure of a bulb.
- Cespitose*, growing in tufts.
- Calcareous*, chalky, chalk-like.
- Calyptra*, applied to the portion of volva covering the pileus.
- Campanulate*, bell-shaped.
- Canaliculate*, channeled.
- Cancellate*, latticed, marked both longitudinally and transversely.
- Cap*, the expanded, umbrella-like receptacle of the common mushroom.
- Capillitium*, spore-bearing threads, variable in thickness and color, sometimes continuous with the sterile base, sometimes free, dense, and persistent, or lax and evanescent, often branched; found in the Lycoperdons.
- Carious*, decayed.
- Carneous*, fleshy.
- Cartilaginous*, hard and tough.
- Castaneous*, chestnut color.
- Ceraceous*, wax-like.
- Channeled*, hollowed out like a gutter.
- Chlorosis*, loss of color.
- Cilia*, marginal hair-like processes.
- Ciliate*, fringed with hair-like processes.
- Cinereous*, ash-colored.

*Circinate*, rounded.

*Clathrate*, latticed.

*Clavate*, club-shaped, gradually thickened upward.

*Close*, packed closely side by side; also styled crowded.

*Columella*, a sterile tissue rising column-like in the midst of the capillitium, serving as a point of insertion for the threads which connect it with the peridium in the form of a net-work.

*Concentric*, having a common center, as a series of rings one within another.

*Connate*, united by growing, as when two or more caps become united.

*Concolored*, of a uniform color.

*Conferoid*, from the finely branched threads.

*Continuous*, without a break, of a surface which is not cracked, or of one part which runs into another without interruption.

*Cordate*, heart-shaped.

*Coriaceous*, of a leathery texture.

*Corrugated*, drawn into wrinkles or folds.

*Corticated*, furnished with a bark-like covering.

*Cortina*, a partial veil formed not of continuous tissue but of slender threads, which in certain mushrooms when young unite the stem with the margin of the cap. This membrane remains later as a filamentous ring on the stem, or threads hanging to the margin of cap. Applied to the peculiar veil of the Cortinariæ.

*Cratera*, a cup-shaped receptacle.

*Crenate*, *crenulate*, notched at the edge, the notches blunt or rounded, not sharp as in a serrated edge, serratures convex.

*Cribose*, pierced with holes.

*Cryptogamia*, applied to the division of nonflowering plants.

*Cupreous*, copper-colored.

*Cuspidate*, with a sharp, spear-like point.

*Cyathiform*, cup-shaped.

*Cystidia*, sterile cells of the hymenium, generally larger than the basidia cells, with which they are found.

*Deciduous*, temporary falling off.

*Decurrent*, as when the gills of a mushroom are prolonged down the stem.

*Deliscent*, a closed organ opening of itself at maturity, or when it has attained a certain development.

*Deliquescent*, relating to mushrooms which at maturity become liquid.

*Dentate*, toothed, with concave serratures.

*Denticulate*, finely dentate.

*Dermini*, brown or rust-colored spores.

*Determinate*, ending definitely; having a distinctly defined outline.

*Diaphanous*, transparent.

*Dichotomous*, paired by twos; regularly forked.

*Dimidiate*, applied to some gills of mushrooms which reach only halfway to the stem.

*Disciform*, of a circular, flat form.

*Dissepiments*, dividing walls.

*Distant*, applied to gills which have a wide distance between them.

*Divarcate*, separating at an obtuse angle.

*Echinate*, furnished with stiff bristles.

*Echinulate*, with minute bristles.

*Effused*, spread over without regular form.

*Elongate*, lengthened.

*Emarginate*, applied to gills which are notched or scooped out suddenly before they reach the stem.

*Embryo*, the mushroom before leaving its volva or egg stage; also any early stage of mushrooms which may have no volva.

*Entire*, the edge quite devoid of serrature or notch.

*Epidermis*, the external or outer layer of the plant.

*Epiphytal*, growing upon another plant.

*Equal*, all gills of the same, or nearly the same length from back to front.

*Eroded*, the edge ragged, as if torn.

*Etiolated*, whitened, bleached.

*Even*, distinguished from smooth; a surface quite plane as contrasted with one which is striate, pitted, etc.

*Excentric*, out of center. The stems of some mushrooms are always excentric.

*Exotic*, foreign.

*Family*, a systematic group in scientific classification embracing a greater or less number of genera which agree in certain characters not shared by others of the same order.

*Farinaceous*, mealy.

*Farinose*, covered with a white, mealy powder.

*Fascia*, a band or bar.

*Fasciate*, zoned with bands.

*Fasciculate*, growing in small bundles.

*Fastigate*, bundled together like a sheath.

*Favose*, honeycombed.  
*Ferruginous*, rust-colored.  
*Fibrillose*, clothed with small fibers.  
*Fibrous*, composed of fibers.  
*Filiform*, thread-like.  
*Fimbriated*, fringed.  
*Fissile*, capable of being split.  
*Fistular*, *fistulose*, tubular.  
*Flabelliform*, fan-shaped.  
*Flavescent*, yellowish, or turning yellow.  
*Flexuose*, wavy.  
*Flocci*, threads as of mold.  
*Floccose*, downy.  
*Flocculose*, covered with flocci.  
*Foveolate*, pitted.  
*Free*, in relation to the gills of mushrooms reaching the stem but not attached to it.  
*Fringe*, a lacerated marginal membrane.  
*Fructification*, reproducing power of a plant.  
*Fugacious*, disappearing rapidly.  
*Furcate*, forked.  
*Fuliginous*, blackish or sooty.  
*Fulvous*, tawny; a rather indefinite brownish yellow.  
*Furfuraceous*, with branny scales or scurf.  
*Fuscous*, brownish, but dingy; not pure.  
*Fusiform*, spindle-shaped.  
*Genera*, plural of genus.  
*Generic*, pertaining to a genus.  
*Genus*, a group of species having one or more characteristics in common; the union of several genera presenting the same features constitutes a tribe.  
*Gibbous*, in the form of a swelling; of a pileus which is more convex or tumid on one side than the other.  
*Gills*, vertical plates radiating from the stem on the under surface of the mushroom cap.  
*Glabrous*, smooth.  
*Glaucescent*, inclining to glaucous.  
*Glaucous*, covered with a whitish-green bloom or fine white powder easily rubbed off.  
*Globose*, nearly spherical.  
*Granular*, with roughened surface.  
*Greaved*, of a stem clothed like a leg in armor.  
*Gregarious*, of mushrooms not solitary but growing in numbers in the same locality.  
*Grumous*, clotted; composed of little clustered grains.

*Guttate*, marked with tear-like spots.  
*Gyrose*, circling in wavy folds.  
*Habitat*, natural abode of a vegetable species.  
*Hepatic*, pertaining to the liver; hence, liver-colored.  
*Heterogeneous*, of a structure which is different from adjacent ones.  
*Hibernal*, pertaining to winter.  
*Hirsute*, hairy.  
*Homogeneous*, similar in structure.  
*Hyaline*, transparent.  
*Hygrophanous*, looking watery when moist and opaque when dry.  
*Hymenium*, the fructifying surface of the mushroom; the part on which the spores are borne.  
*Hymenophore*, the structure which bears the hymenium.  
*Hypogæous*, subterranean.  
*Identification*, the determination of the species to which a given specimen belongs.  
*Identify*, to determine the systematic name of a specimen.  
*Imbricate*, overlapped like tiles.  
*Immarginate*, without a distinct border.  
*Immersed*, sunk into the matrix.  
*Incised*, cut out; cut away.  
*Indehiscent*, not opening.  
*Indigenous*, native of a country.  
*Inferior*, growing below; of the ring of an agaric, which is far down on the stem.  
*Infundibuliform*, funnel-shaped.  
*Innate*, adhering by growing into.  
*Inserted*, growing like a graft from its stock.  
*Involute*, edges rolled inward.  
*Laciniate*, divided into flaps.  
*Lactescent*, milk-bearing.  
*Lacunose*, pitted or having cavities.  
*Lamellæ*, gills of mushrooms.  
*Lanceolate*, lance-shaped; tapering to both ends.  
*Lateral*, attached to one side.  
*Latex*, the viscid fluid contained in some mushrooms.  
*Laticiferous*, applied to the tubes conveying latex, as in the Lactarias.  
*Lepidote*, scurfy with minute scales.  
*Leucospore*, white spore.  
*Ligneous*, woody consistency.  
*Linear*, narrow and straight.  
*Linguiiform*, tongue-shaped.

**Maculate**, spotted.

**Marginate**, having a distinct border.

**Matrix**, the substance upon which a mushroom grows.

**Medial**, at the middle; of the ring of a mushroom which is between superior or near the apex of the stem, and distant or far removed from the apex.

**Merismoid**, having a branched or laciniate pileus.

**Moniliform**, contracted at intervals in the length, like a string of beads.

**Multifid**, having many divisions.

**Multipartite**, divided into many parts.

**Mycelium**, the delicate threads proceeding from the germinating spores, usually white and popularly termed spawn.

**Narrow**, of very slight vertical width.

**Netted**, covered with projecting reticulated lines.

**Nucleus**, contents of spore.

**Obconic**, inversely conical.

**Obcordate**, like an inverted heart.

**Oblique**, slanting.

**Oblong**, longer than broad.

**Obovate**, inversely egg-shaped, broadest at the apex.

**Obtuse**, blunt or rounded.

**Ochrospore**, ocher-colored spore.

**Orbicular**, having the form of an orb.

**Order**, group of a classification intermediate between tribe and family.

**Ostiole**, **ostiolum**, mouth of the perithecium; orifice through which the spores are discharged.

**Ovate**, egg-shaped.

**Pallid**, pale, undecided color.

**Papillate**, **papillose**, covered with soft tubercles.

**Paraphyses**, sterile cells found with the reproductive cells of some plants.

**Parasitic**, growing on and deriving support from another plant.

**Partial**, of a veil clothing the stem and reaching to the edge of the cap but not extending beyond it.

**Patent**, spreading.

**Pectinate**, toothed like a comb.

**Pedicel**, foot-stock.

**Pedicillate**, having a pedicel.

**Pelliculose**, furnished with a pellicle or distinct skin.

**Penciled**, with pencil-like hairs either on the tip or border.

**Peridium**, general covering of a puff-ball, simple or double, dehiscent or indehiscent at maturity.

**Perithecia**, bottle-like receptacles containing asci.

**Peronate**, used when the stem has a distinct stocking-like coat.

**Persistent**, inclined to hold firm, tenacious.

**Pervious**, forming an open tube-like passage.

**Pileate**, having a cap.

**Pileoli**, secondary pilei; arising from a division of the primary pileus.

**Pileus**, the cap, receptacle, or one part of a mushroom; other parts are the stem and gills.

**Pilose**, covered with hairs.

**Pits**, depressions in cells or tubes resembling pores.

**Plumose**, feathery.

**Pore**, orifice of the tubes of polypores.

**Poriform**, in the form of pores.

**Porous**, having pores.

**Powdery**, covered with bloom or powder.

**Projecting**, the anterior end jutting out beyond the margin.

**Proliferous**, applied to an organ which gives rise to secondary ones of the same kind.

**Pruinose**, covered with frost-like bloom.

**Pruniform**, plum-shaped.

**Pubescent**, downy.

**Pulverulent**, covered with dust.

**Pulvinate**, cushion-shaped.

**Punctate**, dotted with points.

**Pyriform**, pear-shaped.

**Quaternate**, arranged in groups of four.

**Receptacle**, a part of the mushroom extremely varied in form, consistency, and size, inclosing the organs of reproduction.

**Remote**, when the margin of the gill comes to an end before reaching the stem.

**Reniform**, kidney-shaped.

**Repand**, bent backwards.

**Resupinate**, of mushrooms spread over the matrix without any stem and with the hymenium upwards; inverted by twisting of the stalk.

**Reticulate**, marked with cross lines like the meshes of a net.

**Revolute**, rolled backwards; of the margin of a cap; the opposite of involute.

**Rhodospore**, rose or pink spore.

*Rimose*, cracked.

*Ring*, a part of the veil adhering to the stem of a mushroom in the shape of a ring.

*Rivulose*, marked with lines like rivulets.

*Rubiginous*, rust colored.

*Rufescent*, reddish in color.

*Rugose*, wrinkled.

*Scabrous*, rough on the surface, scaly.

*Scariosus*, shriveled.

*Scissile*, of two plates lying together but capable of being separated.

*Sclerotoid*, hard; a form assumed by the mycelium of certain mushrooms.

*Scrobiculate*, marked with little pits or depressions.

*Separating*, becoming detached, as gills from the stem or of gills from their matrix.

*Serrate*, saw-toothed; indented like a saw.

*Sessile*, seated without a stalk.

*Simple*, not branched, divided or connected together.

*Sinuate*, of a cap with a wavy margin, or of gills where they have a sudden wave or sinus where they reach the stem.

*Spathulate* or *Spatulate*, spatula-shaped, or spoon-shaped.

*Spaen*, the popular name for mycelium used in the propagation of mushrooms; that from which the perfect fungus arises, reproducing the parent form.

*Species*, an organic body, animal or vegetable, having its peculiar characteristics which differ from the bodies belonging to the same genus.

*Spheroidal*, partaking of the shape of a sphere.

*Spores*, the reproductive bodies of cryptogams; analogous to seeds. The spore in germinating gives birth to the mycelium.

*Sporida*, name given by some mycologists to reproductive spores of the mother cell.

*Sporophore*, name given by some naturalists to the basidia.

*Squamosae*, having scales.

*Squamulose*, covered with small scales.

*Squarrose*, rough, with projecting or deflexed scales.

*Stoloniferous*, applied to a trailing and rooting branch.

*Stellate*, star-shaped.

*Stem*, the ascending axis of plants.

*Stigmata*, applied to the fructification of the hymenomycetes; the slender and delicate supports of the spores on the basidium cell.

*Stipe*, name applied to the stem of mushrooms.

*Stipitate*, having a stem.

*Straight*, the edge plane and even.

*Striate*, streaked with longitudinal lines.

*Strigose*, covered with sharp, rigid lines in the form of channels.

*Strobiliform*, pineapple shape.

*Stuffed*, of a stem filled with substance of a different texture from its walls.

*Sub*, commonly employed as a diminutive.

*Subiculum*, the thready mycelium forming the under layer of the mushroom.

*Subulate*, awl-shaped; narrowing and tapering from base to apex.

*Sulcate*, furrowed.

*Superior*, the upper surface; applied to the ring when near the apex of the stem.

*Theca*, cell-mother, the protoplasm of which originates by segmentation; a certain number of spores, usually eight, held in suspension in the protoplasm of the theca without being attached to each other or to the cell walls.

*Thecasore*, the spore thus encased.

*Tomentose*, downy, with short hairs.

*Torsive*, spirally twisted.

*Torulose*, a cylindrical body swollen and restricted alternately.

*Toxic*, poisonous.

*Trama*, the substance proceeding from the hymenophore, intermediate between the plates (central in) of the gills of agarics.

*Transverse*, crosswise.

*Tremeloid*, jelly-like.

*Truncate*, ending abruptly, as if cut short; cut squarely off.

*Tubæform*, trumpet-shaped.

*Tubercle*, a small wart-like excrescence.

*Tubular*, hollow and cylindrical.

*Turbinate*, top-shaped.

*Typical*, agreeing closely with the characters assigned to a group or species.

*Umbilicate*, having a central depression.

*Umbo*, the boss of a shield; applied to the central elevation of the cap of some mushrooms.

*Umbonate*, having a central boss-like elevation.

*Uncinate*, hooked.

*Unequal*, short imperfect gills interspersed among the others.

*Universal*, used in relation to the veil or volva which entirely envelops the mushroom when young.

*Variety*, an individual of a species differing from the rest in external form, size, color, and other secondary features, without perpetuating these differences only under exceptional circumstances.

*Veil*, in mushrooms a partial covering of the stem or margin of the pileus.

*Veliform*, a thin veil-like covering.

*Venate*, *Veined*, intersected by swollen wrinkles below and on the sides.

*Ventricose*, swollen in the middle.

*Vernicose*, shining as if varnished.

*Verrucae*, warts or glandular elevations.

*Verrucose*, covered with warts.

*Villosa*, *villous*, covered with long, weak hairs.

*Virescent*, greenish.

*Virgate*, streaked.

*Viscid*, covered with a shiny liquid which adheres to the fingers when touched.

*Viscous*, gluey.

*Volute*, rolled up in any direction.

*Volva*, a substance covering the mushroom, sometimes membranous, sometimes gelatinous; the universal veil.

*Walnut brown*, a deep brown like that of some varieties of wood. (Raw umber, and burnt sienna and white.)

*Wart*, an excrescence found on the cap of some mushrooms; the remains of the volva in form of irregular or polygonal excrescences, more or less adherent, numerous, and persistent.

*Zone*, a broad band encircling a mushroom.

*Zoned*, furnished with one or more concentric circles.



